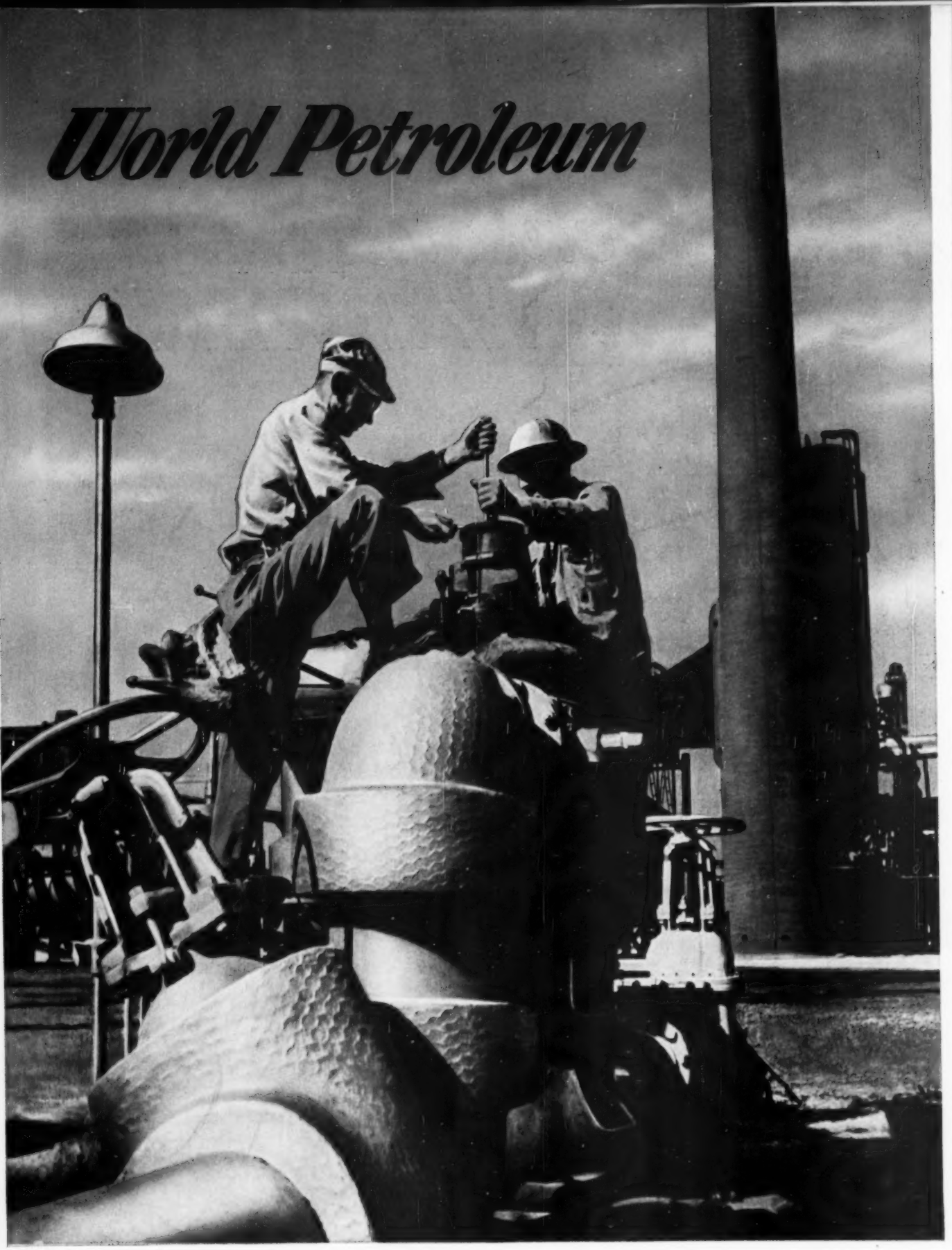
World Petroleum

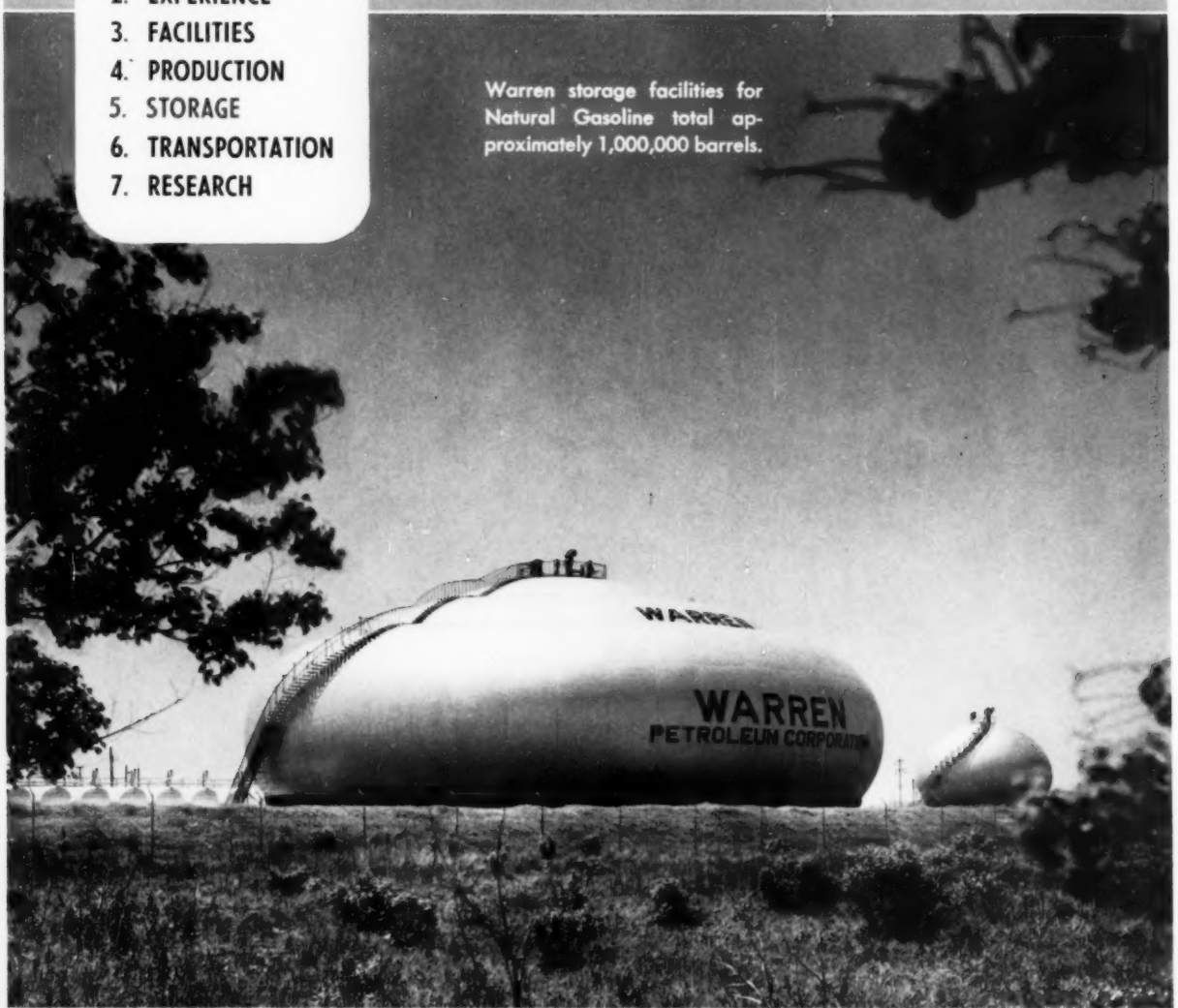


Nineteenth Annual Refinery Issue — 1949

ONE DOLLAR

7 Reasons WHY IT'S WARREN

1. PERSONNEL
2. EXPERIENCE
3. FACILITIES
4. PRODUCTION
5. STORAGE
6. TRANSPORTATION
7. RESEARCH



WARREN PETROLEUM CORPORATION

Producers, Manufacturers, Exporters and Marketers

Export Terminals: Corpus Christi, Port Arthur, Baytown, Texas City, and Norsworthy, Houston, Texas.

TULSA 2, OKLAHOMA CABLE ADDRESSES: Stavolene, Warren

Crude Oil, Natural Gasoline and Liquefied Petroleum Products

THREE TYPES OF HORTON TANKS
SERVING THE PETROLEUM INDUSTRY

1. HORTONSPHERES...

The Hortonsphere provides the most efficient, most economical means of storing butane and other volatile liquids under 30 to 150 lbs. per sq. in. pressure. It is supported above ground on cylindrical columns, facilitating the inspection and maintenance of entire shell of the structure. Standard designs include units up to 65 ft. in diameter for gases or 25,000-bbl. capacity for liquids. Send for Bulletin F for complete information.

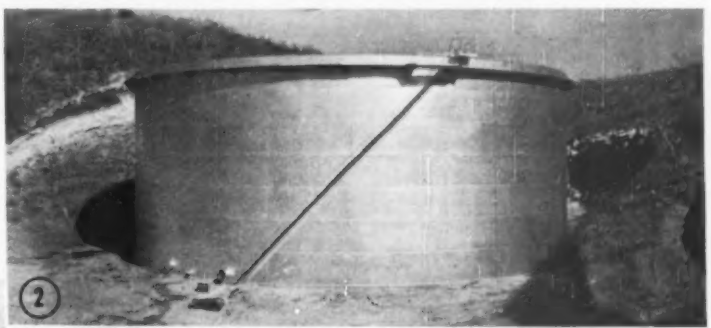
2. HORTON DOUBLE-DECK FLOATING ROOFS...

Tanks equipped with Horton Double-Deck Floating Roofs save the most when worked the hardest. They eliminate all filling and emptying losses and reduce standing storage losses to a minimum. They will pay off their investment cost in the shortest period of time when used on new or existing flat-bottom tanks that are filled and emptied often. Bulletin B contains complete engineering data on Floating Roofs.

3. HORTONSPHEROIDS...

A "natural" for natural gasoline—and products of similar volatility whose storage losses can be controlled by a fairly low internal pressure. Here the Hortonspheroid is ideal because it is the most economical means of storing a *large* volume of such products under the proper pressure. Available in capacities from 2,000 to 120,000 bbls. with working pressures from 2½ to 100 lbs. per sq. in. Bulletin E describes Hortonspheroids in detail.

(1) 38-ft. diam. Hortonsphere for the Creole Petroleum Corporation at Mulata, Venezuela.



(2) Above: Oil storage tank with Horton Double-Deck Floating Roof for Mene Grande Oil Co., Puerto La Cruz, Venezuela. (3) At left: 100,000-bbl. Hortonspheroid installed for Curacao, Netherlands Antilles.

Other HORTON products manufactured by Chicago Bridge & Iron Company include:

- VAPORSPHERES
- VAPORDOME ROOFS
- LIFTER ROOFS
- HEMISPHEROIDS
- OIL STORAGE TANKS

CHICAGO BRIDGE & IRON COMPANY

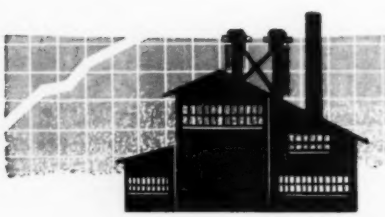
Chicago • Houston • Tulsa • San Francisco • Birmingham • Atlanta • Cleveland • Philadelphia • Los Angeles • Salt Lake City • Boston • Seattle • Detroit
Plants: Birmingham, Chicago, Salt Lake City and Greenville, Pa., U.S.A. Export Office—165 Broadway Building, New York 6, N. Y., U.S.A.

REPRESENTATIVES AND LICENSEES

Ateliers et Chantiers de la Seine Maritime, Paris, France
Construction Metalliques de Provence, Aries-sur-Rhone, France
Chicago Bridge & Iron Company, Ltd., Apartado 1348, Caracas, Venezuela
Compagnia Tecnia Industrie Petroli, Via Sapri 7, Rome, Italy
Whessoe, Limited, Darlington, England
Motherwell Bridge & Engineering Company, Limited, Motherwell, Scotland
Hortos Steel Works, Limited, Fort Erie, Ontario, Canada
W. P. Bryant, Edificio Abreu 402, Havana, Cuba

ATTAPULGUS "AAA"...

A new percolation clay
Setting new efficiency records



Attapulgus—foremost name in fullers earth—now offers a *new* percolation clay, the high efficiency of which has been proved by many months use in one of the larger oil refineries in the country.

Its name—Attapulgus "AAA" Grade Clay.

Its record:

REDUCED CLAY COSTS. With most oils, "AAA" has 10% to 20% more refining efficiency than other available percolation clays—a superiority maintained over the entire life of the clay. This permits using "AAA" through more cycles, reducing clay costs by 15% to 25%.

OPERATING CREDITS. The higher percolation yields per ton of "AAA" clay mean fewer filter turnovers, less clay to burn, lower oil and naphtha losses, reduced steaming costs, lower maintenance costs on burner equipment, etc. These savings are two to three times as great as the reduction in clay costs.

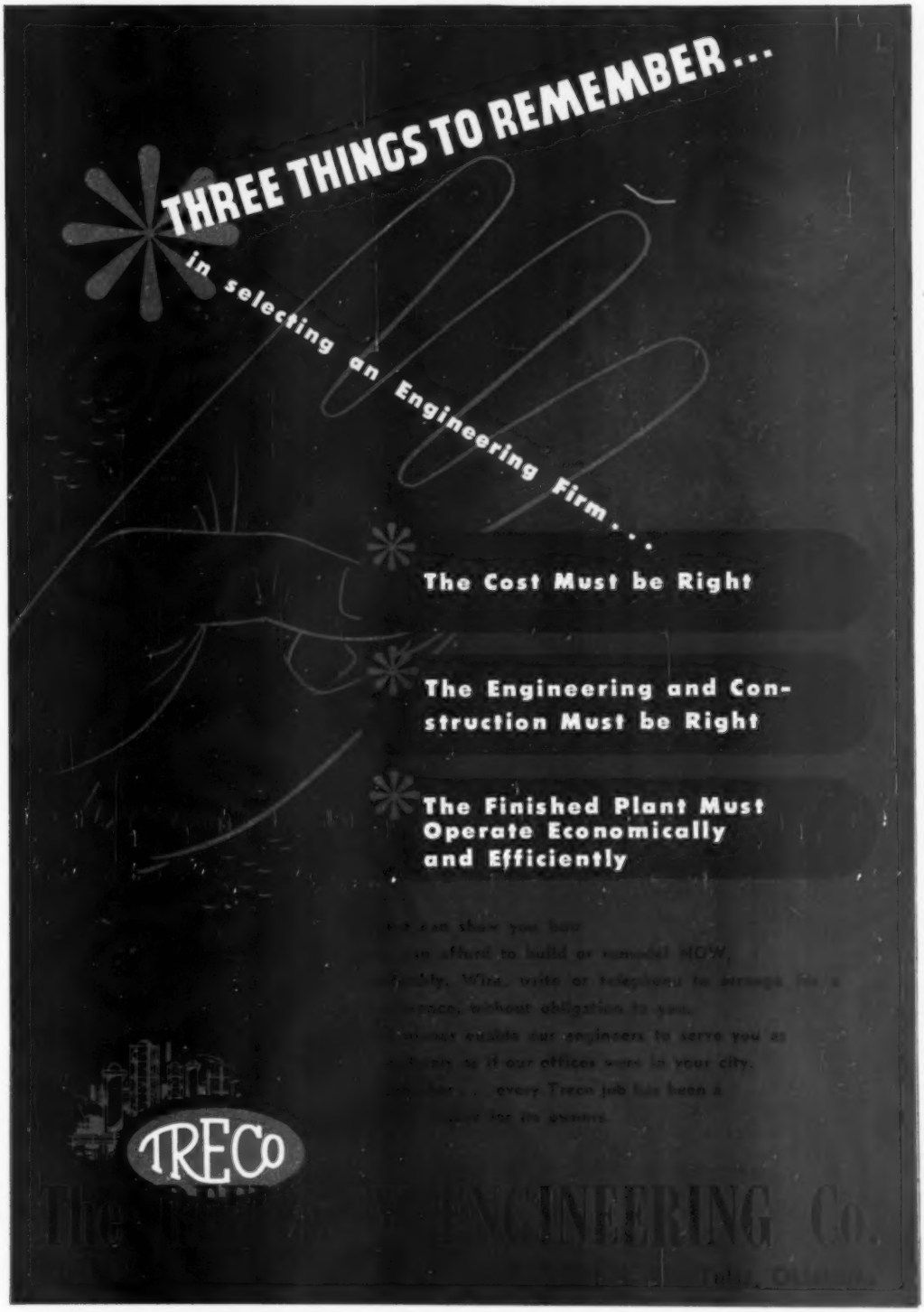
INCREASED YIELDS. Just install "AAA" and yields go up. The same production can be maintained at a lower unit product cost. Or, "AAA" will give your present facilities added capacity.

"AAA" Grade Clay is available in standard percolation meshes—in bags or bulk.

We are ready to assist you in its evaluation for your particular filtering operation.

ATTAPULGUS CLAY COMPANY

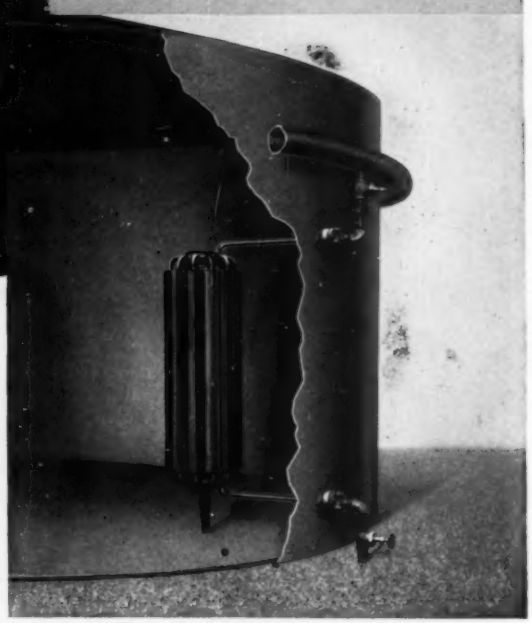
Dept. X, 210 West Washington Square, Phila. 5, Pa.


THREE THINGS TO REMEMBER...
in selecting an Engineering Firm...
The Cost Must be Right
The Engineering and Construction Must be Right
The Finished Plant Must Operate Economically and Efficiently
TRECo

WORLD PETROLEUM for July 20, 1949, Vol. 20, No. 8. July 20, 1949. WORLD PETROLEUM is published monthly by Mona Palmer, Trustee under the will of Russell Palmer, 2 W. 45th St., New York 19, N. Y. Acceptance under the Act of June 5, 1934, at East Stroudsburg, Pa., Authorized September 23, 1946. Subscription rate: $5.00 per year, single copies 50c.

THEY'RE *New -- Better, Cheaper and More Efficient*

BROWN FINTUBE *Thermo-Flo* TANK HEATERS



● Brown Fintube THERMO-FLO Tank Heaters are service proved — and offer many advantages as compared to the old method of using a bare pipe coil on the bottom of the tank.

EASY INSTALLATION—THERMO-FLO heaters are compact units. They will pass through a standard 20 inch manway with ample clearance.

REDUCED FOULING—The vertical mounting practically eliminates depositing on the tubes, and avoids the necessity of heating through a layer of sediment.

EFFICIENT HEAT TRANSFER — THERMO-FLO heaters set up a thermal siphon or "flow" within the tank, resulting in highly efficient heat transfer — and avoiding stratification.

LOW VOLUME DISPLACEMENT—Due to Brown's exclusive finned tube construction, each lineal foot of fintube in the THERMO-FLO heater has the surface equivalent of 6 lineal feet of plain bare pipe.

STURDY CONSTRUCTION — THERMO-FLO heaters are built to a standard design — in low cost production quantities — and are completely assembled and tested before shipment.

INEXPENSIVE—Users report that the cost of a group of Brown Fintube THERMO-FLO heaters — plus their installation — is *less* than just the installation of a bare pipe coil having equivalent heating capacity.

EASY MAINTENANCE—THERMO-FLO heaters can be removed from the tank easily and repaired or cleaned *outside* the tank,— or a damaged heater can be replaced with another standard heater from stock.

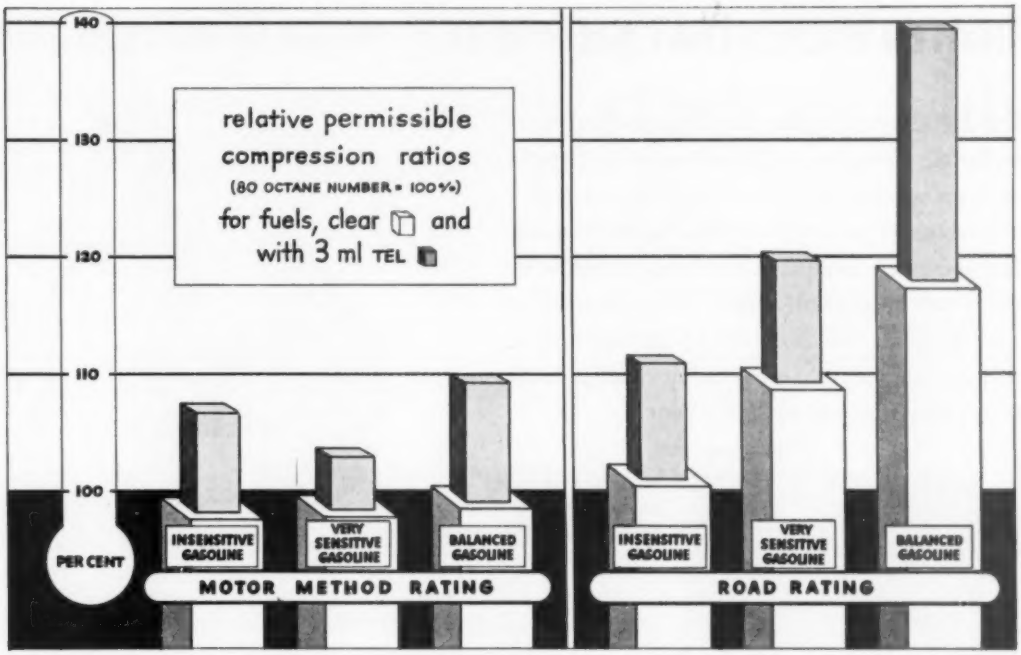
HIGHLY FLEXIBLE—THERMO-FLO heaters can be installed in new or existing tankage and additional units can be added to meet changing conditions.

MEET ANY REQUIREMENT—THERMO-FLO heaters can be installed singly or in groups. Fabricated from mild steel, stainless steel, monel, everdur, admiralty or other metals, to meet individual conditions.

Bulletin No. 491 Gives Full Details.
Write for a copy. Today!

THE BROWN FINTUBE CO.
ELYRIA, OHIO

FINTUBE HEAT TRANSFER PRODUCTS



*Boosting "lead response" with balanced gasoline**

ETHYL research has shown that the hydrocarbon distribution over the boiling range of a gasoline has a big influence upon its road performance . . . the final criterion of any motor gasoline.

The charted study showing the gain in antiknock quality from the addition of 3 milliliters of tetraethyllead to base gasolines of three representative types—an insensitive, a very sensitive, and a balanced gasoline—tells a clear-cut story of balanced gasoline superiority. The vertical scale of the chart is proportional to the relative permissible compression ratio, with 100% corresponding to that allowable with a blend of standard reference fuels of 80 octane number.

Each of the three base fuels has a Motor method rating of approximately 80. When tetraethyllead is added to the insensitive gasoline, its antiknock quality is improved 8%. The very sensitive gasoline shows only half that improvement, whereas the balanced gasoline gives an improvement somewhat greater than that obtained with the insensitive gasoline.

Rated on the road, the insensitive gasoline yields a somewhat greater improvement than it did by the Motor method. In the very sensitive gasoline, the improvement is virtually the same as the improvement in the insensitive gasoline.

When the balanced gasoline is rated in cars on the road the benefits are spectacular. For now the improvement in antiknock quality resulting from tetraethyllead is more than double that obtained in the very sensitive gasoline. Furthermore, with tetraethyllead the balanced gasoline shows a much greater increase in road rating over Motor method rating than does the very sensitive gasoline. A comparison of the Motor method ratings of the unleaded base fuels with the road ratings of the leaded base fuels indicates that the balanced gasoline has a 93% greater improvement overall than the very sensitive gasoline.

The Ethyl Laboratories study the principles of "balancing" gasoline for optimum tetraethyllead effectiveness on the road as a service to refiners in their efforts to obtain the highest measure of performance from every drop of "Ethyl" antiknock compound.

**A balanced gasoline has a distribution of hydrocarbon types with respect to boiling range so controlled that it will give optimum road antiknock quality and improvement from the addition of tetraethyllead at all engine speeds.*

Since 1923—*continuous research to provide better antiknock service*

ETHYL CORPORATION
RESEARCH LABORATORIES

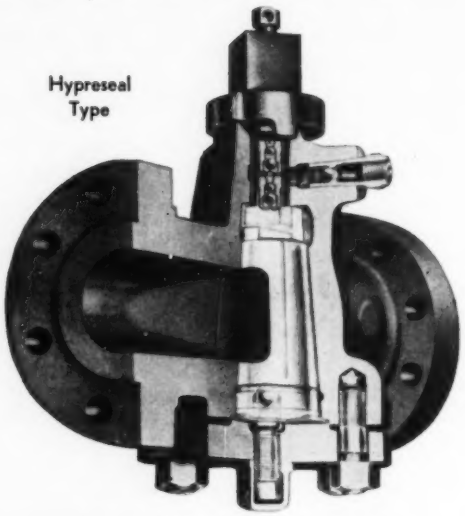
Detroit, Michigan, 1600 West Eight Mile Road • San Bernardino, California, 2600 Cajon Road

Audco-Nordstrom

BRITISH AMERICAN

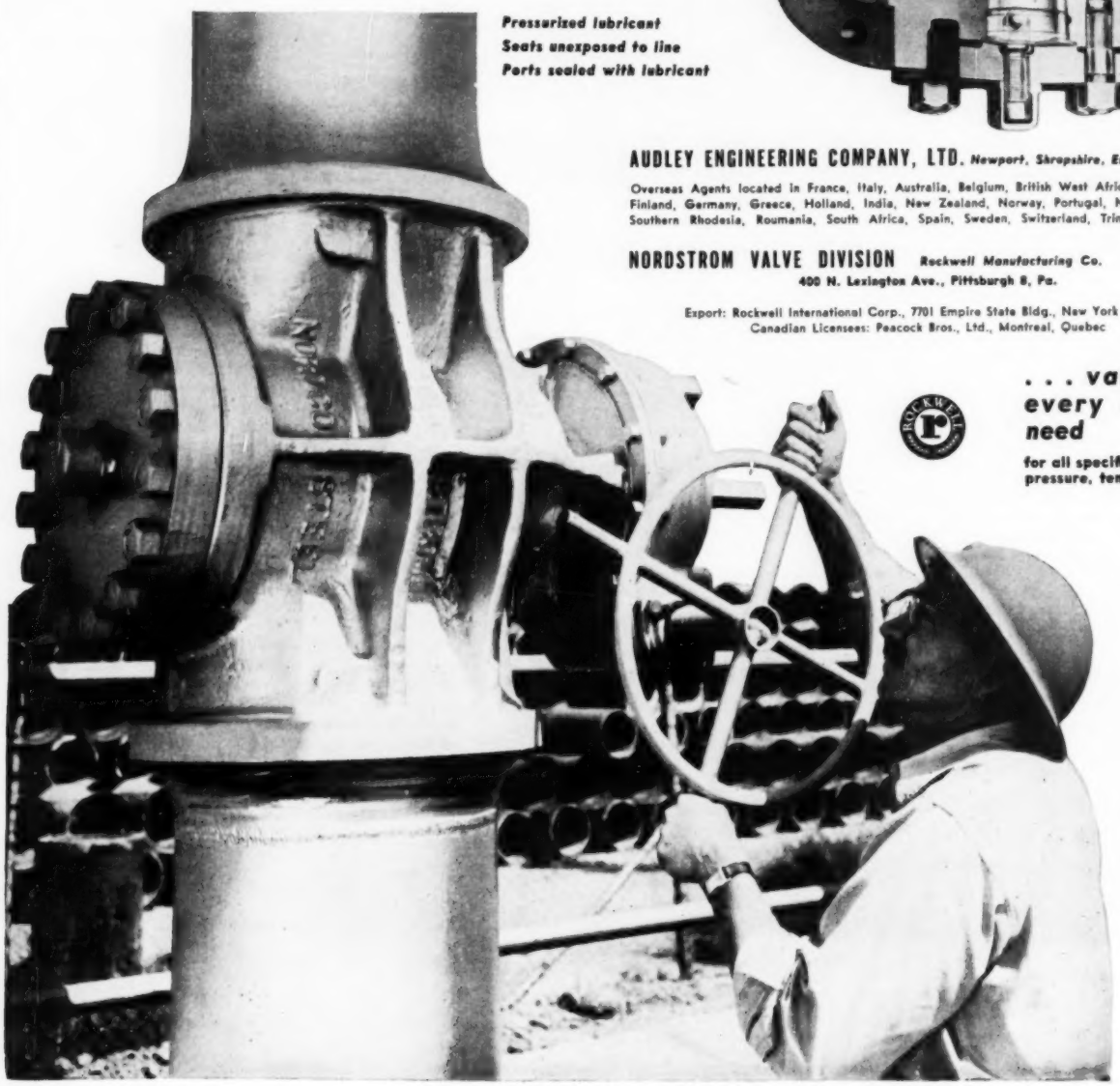
THE LUBRICATED VALVES THAT KEEP UPKEEP DOWN IN MODERN REFINERIES

REFINERIES have actually become chemical processing plants. Complex combinations of conditions involve temperature, pressures, erosive and corrosive characteristics of line contents. Refinery operations impose many conditions that only a lubricated plug valve can successfully meet. The most stringent specifications are best met by installation of Audco-Nordstrom valves. Many refinery units could not successfully function without them.



Hypreseal Type

Pressurized lubricant
Seats unexposed to line
Parts sealed with lubricant



AUDLEY ENGINEERING COMPANY, LTD. *Newport, Shropshire, England*

Overseas Agents located in France, Italy, Australia, Belgium, British West Africa, Denmark, Eire, Finland, Germany, Greece, Holland, India, New Zealand, Norway, Portugal, Northern Rhodesia, Southern Rhodesia, Roumania, South Africa, Spain, Sweden, Switzerland, Trinidad.

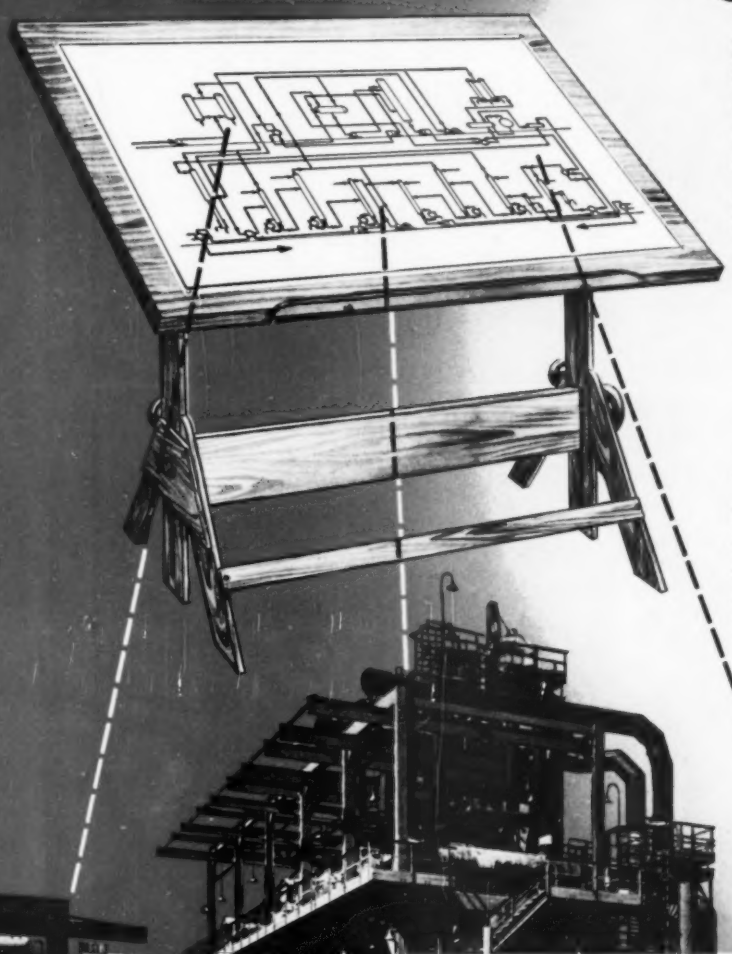
NORDSTROM VALVE DIVISION *Rockwell Manufacturing Co.*
400 N. Lexington Ave., Pittsburgh 8, Pa.

Export: Rockwell International Corp., 7701 Empire State Bldg., New York 1, N. Y.
Canadian Licensees: Peacock Bros., Ltd., Montreal, Quebec

. . . valves for every refinery need

for all specifications of size, pressure, temperature

unified responsibility from start to finish



As Designer and Constructor for the process industries, Badger offers a completely integrated engineering service — from initial consultation to operation of the completed plant. All phases of the installation of a new manufacturing facility are under the supervision and responsibility of one coordinated group. Major divisions of these complete services are:

1. Analysis of manufacturing requirements.
2. Economic analyses and selection of processing methods.
3. Process design.
4. Preparation of detailed designs.
5. Procurement of materials.
6. Field construction.
7. Supervision of initial operation.

This unified responsibility for all phases of new process plant installations prevents overloading your own organization, insures the most economical installation, early completion and dependable operation. The entire project has the benefit of our broad background of experience in the petroleum, chemical and petro-chemical fields.

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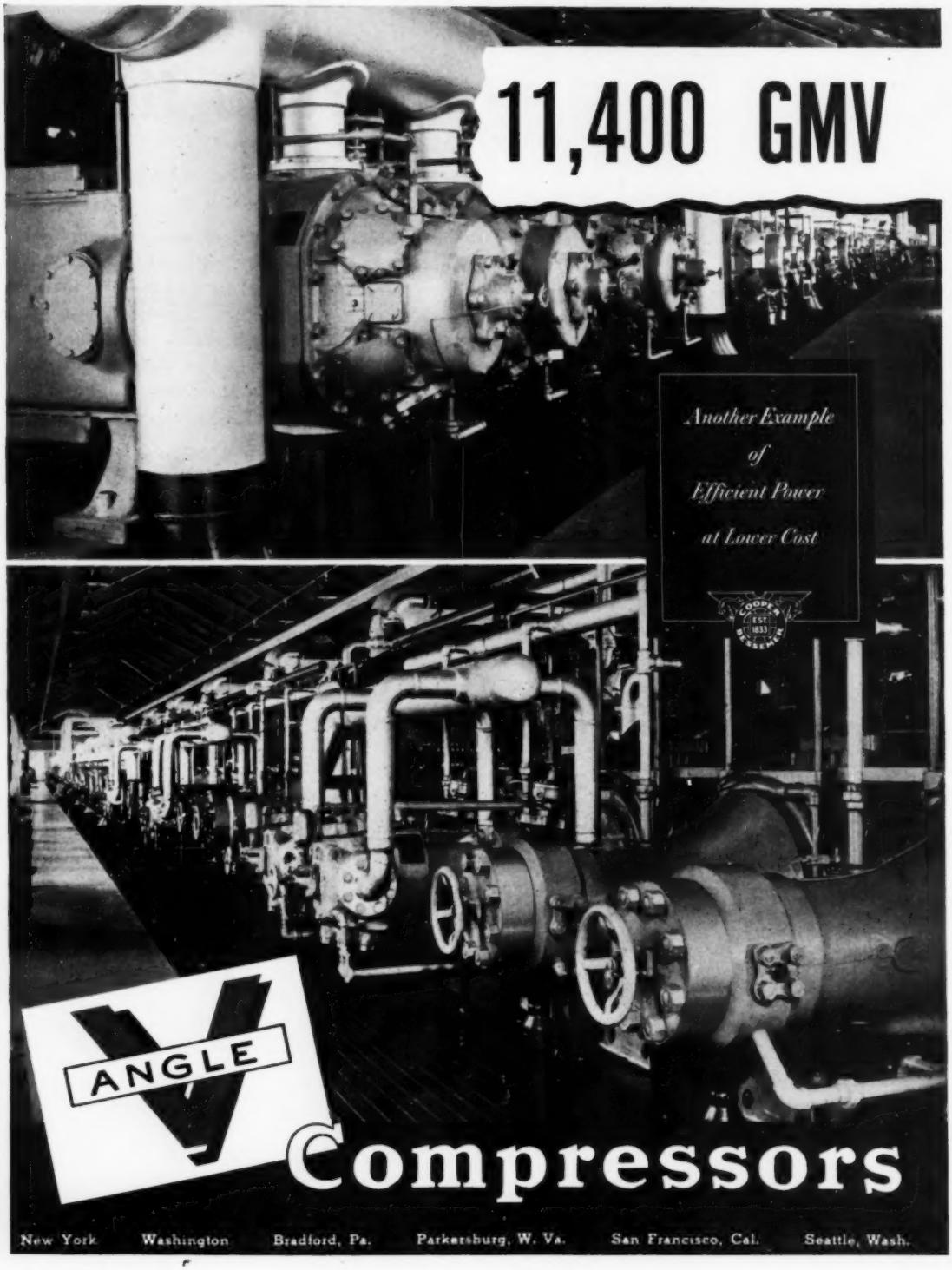
PROCESS ENGINEERS AND CONSTRUCTORS FOR THE PETROLEUM, CHEMICAL AND PETRO-CHEMICAL INDUSTRIES

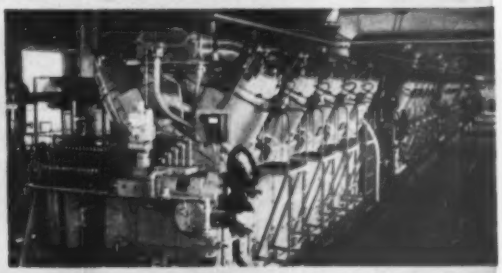

11,400 GMV
Another Example
of
Efficient Power
at Lower Cost
ANGLE
Compressors
New York
Washington
Bradford, Pa.
Parkersburg, W. Va.
San Francisco, Cal.
Seattle, Wash.

HORSEPOWER . . . hub of Stanolind's unique, multi-purpose operation in the Hastings field

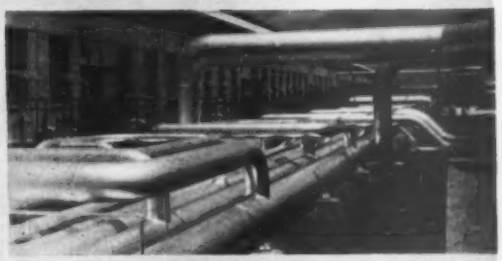
Twelve (12) modern Cooper-Bessemer GMV compressors shoulder an unusual multi-purpose job in Stanolind Oil and Gas Company's big, new, Hastings plant. This includes gas compression not only for natural gasoline processing, but for gas lift work in the field and underground storage as well.

All told, there are five stages of compression, from vacuum to a maximum of 5,000 psi — believed to be the widest compression range within the industry to date. Here also is the first application of underground residue gas storage in the Texas Gulf Coast area.

In this compressor installation, extreme flexibility is one of the prime essentials. The Cooper-Bessemer V-angles have a long and outstanding record of flexibility, adaptability to widely varying demand in pressure and flow. For that matter, you'll find these modern units to be outstanding in *many* ways . . . always adding up to efficient, dependable performance at low cost!



Engine view of 10 cylinder 1000 hp GMV compressor units from crank-door side showing V-type design, ignition and auxiliary lubrication equipment.

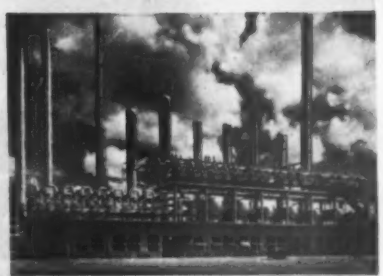


Low pressure manifolding for wet gas system. Block valves permit separation of system into two complete parts with separate inlet scrubbers, coolers and separators.

Six of nine 1000 hp GMV's handling wet gas into the Stanolind Oil & Gas Company's Hastings gasoline plant for processing. Each unit has 4 compressor cylinders for 3-stage compression from vacuum to 715 psia, handling 30 to 40 million cu. ft. per day. Units have semi-automatic, pneumatically operated unloading.

Foreground: Three 800 hp GMV's raise residue gas pressure through the first stage to 1570 psia or through the second stage to a discharge pressure of 3515 psia to 5000 psi maximum, with a capacity range up to 28½ million cu. ft. per day.

Three-story distillation structure shows coolers, main oil exchangers, accumulators, and enclosed pump room. The 10-cylinder GMV's deliver wet gas to absorbers at extreme left.



by Cooper-Bessemer

MOUNT VERNON, OHIO AND GROVE CITY, PENNA.

Houston, Dallas, Greggton, Pampa and Odessa, Texas Tulsa Shreveport St. Louis Los Angeles

For greater operating efficiency and economy in all these world markets . . .

Quality petroleum products

Section of Refinery at Bahrein, Persian Gulf—one of the many Caltex installations.

CALTEX
REG. T. M.

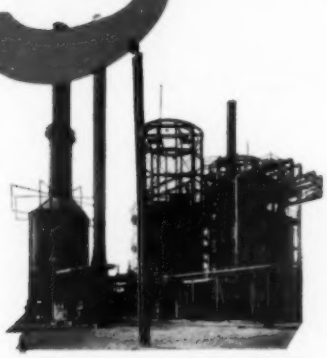
WHETHER it is miles or merchandise—Caltex is an important factor throughout a large part of the world. In both transportation and industry Caltex Quality petroleum products provide operating efficiency and economy—longer life for ships, planes, cars, trucks and rolling stock, greater output at lower unit costs in industry.

Caltex production and refining facilities plus the availability of Caltex products at principal ports and terminals assure these benefits. And to see that Caltex users get the full benefits, skilled technical aid is available at these same world supply points.

CALTEX PETROLEUM PRODUCTS

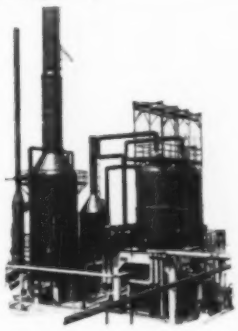
***Offices in U. S. A.:* 551 Fifth Avenue, New York 17, N. Y.**
***Cable Address:* "CALTEX, N. Y."**

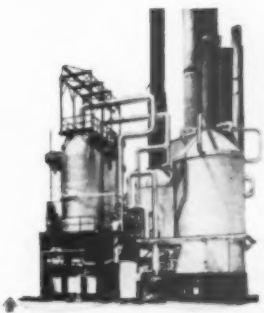
5 More PERCO* Units



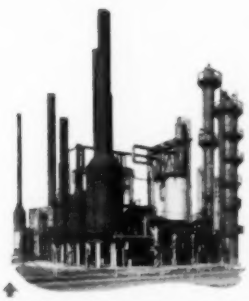
WOOD RIVER OIL & REFINING CO., INC., Hartford, Ill. — 10,000 B/D Straight Run and Cracked Gasoline Reforming and Gas Oil Cracking.

KANOTEX REFINING COMPANY, Arkansas City, Kansas — 4,200 B/D Straight Run and Cracked Gasoline Reforming.

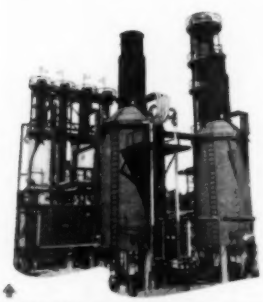




NATIONAL COOPERATIVE REFINERY ASSOCIATION, McPherson, Kansas — 5,000 B/D Straight Run and Cracked Gasoline Reforming.



BARECO OIL COMPANY, Wichita, Kansas — 4,000 B/D Straight Run and Cracked Gasoline Reforming.



ROOSEVELT OIL & REFINING CORP., Mt. Pleasant, Michigan — 3,000 B/D Straight Run Gasoline Desulfurization Reforming.

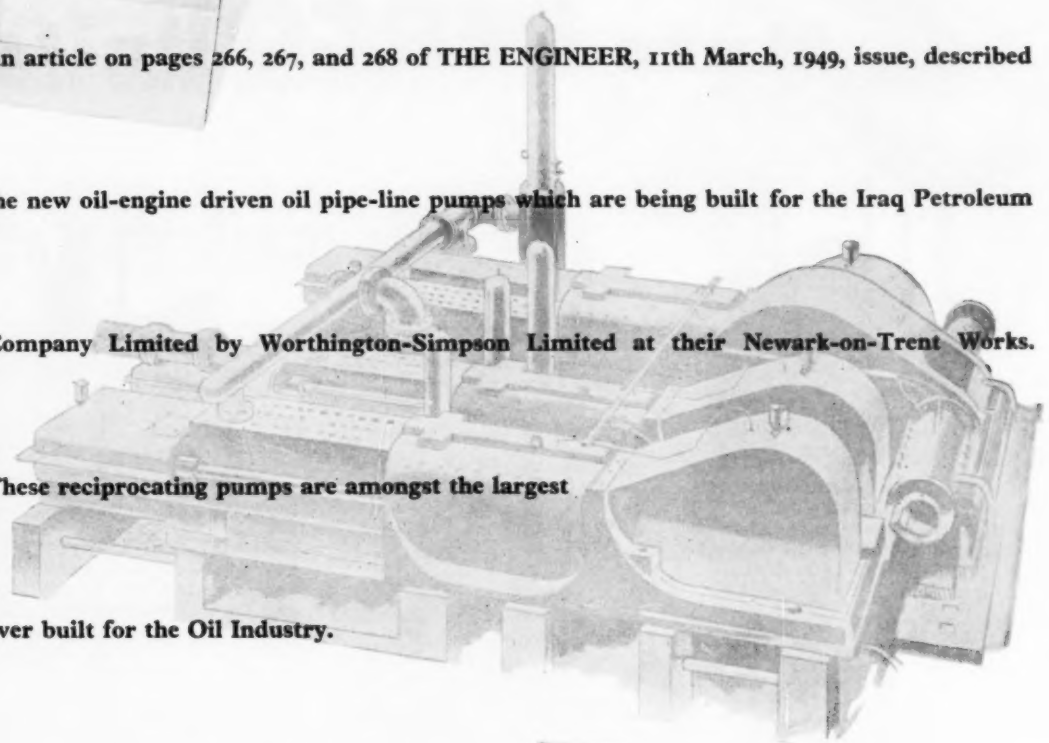
engineered by KOCH

5 more refiners are far ahead in the octane race because they chose Perco catalytic reforming units. With Perco units they can upgrade the leaded octane ratings of their gasolines by 6 to 8 numbers or more. Regardless of size, these Perco units cost less and are far more flexible than thermal reforming units. The economical design of a Perco unit requires years of "know how" — the kind of experience Koch has obtained by building many more Perco units than any other company. We will be glad to tell you how much a Perco unit will cost and what it will do for you . . . no obligation. *Write us, today.*

★ Licensed by Phillips Petroleum Company

THE KOCH ENGINEERING COMPANY, INC.
DESIGNERS • MANUFACTURERS • BUILDERS
335 WEST LEWIS STREET • WICHITA 2, KANSAS

An article on pages 266, 267, and 268 of THE ENGINEER, 11th March, 1949, issue, described the new oil-engine driven oil pipe-line pumps which are being built for the Iraq Petroleum Company Limited by Worthington-Simpson Limited at their Newark-on-Trent Works.



These reciprocating pumps are amongst the largest ever built for the Oil Industry.

The performance of the pumps is described in this extract from the article.....

"The designed output of each pump is 1,200 gallons of oil per minute, corresponding to 50,000 barrels per day, delivered at a pressure of 1,000 lb. per square inch."

The glands of the pumps are packed with SUPERSEAL NO. 3 Plastic Metallic Packing supplied in pre-compressed ring form.

SUPERSEAL is one of the finest gland service packings manufactured. Supplied in five standard forms:

No. 2. For super heated steam, hot oil, gases where temperatures reach 600°F and above.

No. 3. For water, mild chemicals, oils, petroleum distillates and solvents where temperatures do not exceed 600°F.

No. 4. Non-metallic, for foods, fruit juices, edibles, etc.

No. 5. Non-metallic, for chemicals, caustic alkali, and acids.

No. 6. Non-metallic, for extremely high temperatures, steam or gases.

Supplied in spiral or ring form.

Send for a copy of our **Gland Service** *Recommendation Chart, now about to be published.*

Crane Packing LTD. OF SLOUGH ENGLAND
A TI COMPANY

Telephone: Slough 21334. Telegrams: CRANPAC, Slough.

▲ Shown above is the recently added LPG system that is "squeezing the last drop" from what was formerly fuel gas in this refinery.

The BARECO refinery at Wichita, Kansas processing crude at the rate of 6,500 b/d had an excess of propane residue being burned as plant fuel.

Installation of a new LPG processing unit, designed and constructed by Born Engineering Company, recovers better than 125 barrels of propane daily which not only "squeezes the last drop" but shows an excellent return on the investment.

If you are thinking of modernizing your refinery or natural gasoline plant, a Born engineer can show you the efficient, economical way to do it.

BORN Engineering Company

ENGINEERS and CONTRACTORS

TULSA, OKLAHOMA

Representatives: LOS ANGELES, CALIF., G. R. Nance & Co. — SHREVEPORT, LA., Bass Sales & Equipment Co.

Canadian Associates: BRANDON, MANITOBA, Canadian Brown Steel Tank Co., Ltd.

America Needs '49ers

JUST a hundred years ago, the Forty-niners stormed the gold fields of California. They faced staggering obstacles, sure hardship, uncertain reward. Thousands failed, thousands of others realized modest gain, a few made fortunes. None sought or received help or direction from a benevolent government.

Now a century later, America faces another age of golden opportunity--an era when science and industry reveal new treasure to be had for the making. Turning today's visions into reality calls for '49ers--men of purpose and resolution, courage and independent spirit. You as a leader in your community may find a personal challenge and an inspiration in the Old '49er. By example and precept, you can help America toward her greatest accomplishments--in prosperity and peace.

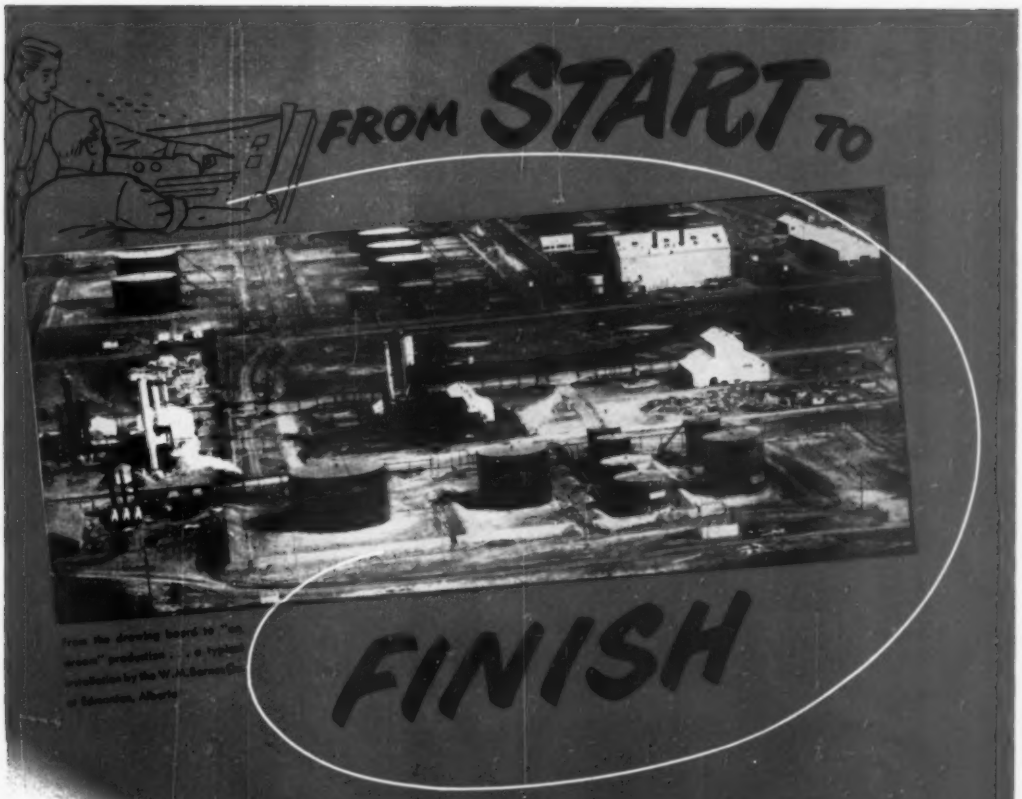
The Youngstown Sheet and Tube Company

General Offices--Youngstown 1, Ohio

Export Offices--500 Fifth Avenue, New York

MANUFACTURERS OF CARBON, ALLOY AND YOLOY STEELS

ELECTROLYTIC TIN PLATE - COKE TIN PLATE - WIRE - COLD FINISHED CARBON AND ALLOY BARS - PIPE AND TUBULAR PRODUCTS - CONDUIT - RODS - SHEETS • PLATES • BARS • RAILROAD TRACK SPIKES.



A complete refinery moved from Whitehorse, Yukon Territory to Edmonton, Alberta, Canada against the most staggering odds . . . Another from the Los Angeles Basin to Naples, Italy . . . Still another, from Santa Fe Springs, California to Antwerp, Belgium—*and all in record time.*

When you come to Barnes, everything is completely arranged from start to finish—from the carefully engineered drawings to full "on stream" production.

For improved efficiencies with substantial savings on Process Design, Engineering and Construction, investigate our services for your next project.

W. M. BARNES COMPANY

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Refiners, petro-chemical processors, chemical manufacturers and a wide range of others in the petroleum and process industries are finding the service of the Graver Construction Co. a valuable asset in these days of expansion and modernization.

It is a complete service that integrates *all* phases of your construction job . . . from engineering and planning, through material procurement to on-the-site erection. Graver men and equipment are available at strategic locations . . . ready to start your job.

Call Graver *now*. Get the details on this construction service that's tailor-made for the petroleum and process industries.

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DU PONT TETRAETHYL LEAD COMPOUNDS

DuPont Services...

are fitted to your needs

Available to the Refining Industry are the specialized services which Du Pont provides in connection with its Tetraethyl Lead Compounds.

Whether it is a problem of determining lead susceptibility of stocks or of checking octane number on finished blends, there is a convenient District Laboratory to help. On safety or health problems associated with lead blending or handling, safety and medical personnel are always available to work with you.

These services—medical, safety, technical, and sales—stand ready at all times to assist in the solution of any problems involving the use of Du Pont TEL Compounds and other additives.

MEDICAL SERVICE

SAFETY SERVICE

DISTRICT LABORATORIES

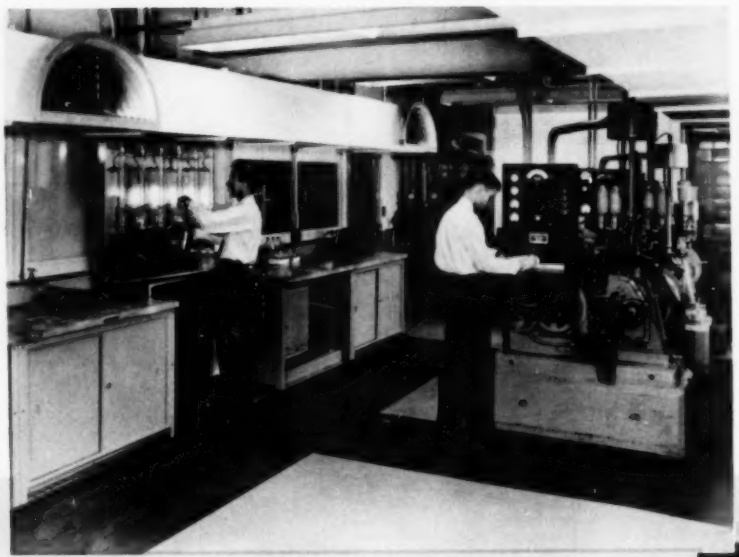
SALES SERVICE

DU PONT
REG. U. S. PAT. OFF.

Better Things for Better Living . . . *Through Chemistry*

Du Pont

MEDICAL SERVICES cooperate with the refiner to maintain the highest degree of industrial hygiene possible among employees engaged in the handling of tetraethyl lead compounds. Periodic examination of all personnel working with TEL is only one part of the services which help in the establishment of safe operating procedures and the indoctrination of personnel in these approved methods.



DISTRICT LABORATORIES, five of which are conveniently located throughout the country, provide prompt, dependable laboratory tests. They are equipped and staffed with experienced men to furnish technical assistance in the application and use of Du Pont TEL compounds as well as other additives.

Provides These Services
to Help You Produce Better Fuels...

SAFETY SERVICES are ready day and night to give prompt aid and advice on safety problems associated with the handling of TEL compounds or of fuels containing them. Safety service representatives are completely equipped with special instruments and tools and are available to refiners for use on safety problems.

DISTRICT OFFICES, located at Wilmington, Delaware; Chicago, Illinois; Tulsa, Oklahoma; Houston, Texas; and Los Angeles, California serve as centers through which the technical, safety and medical services are made available to you.

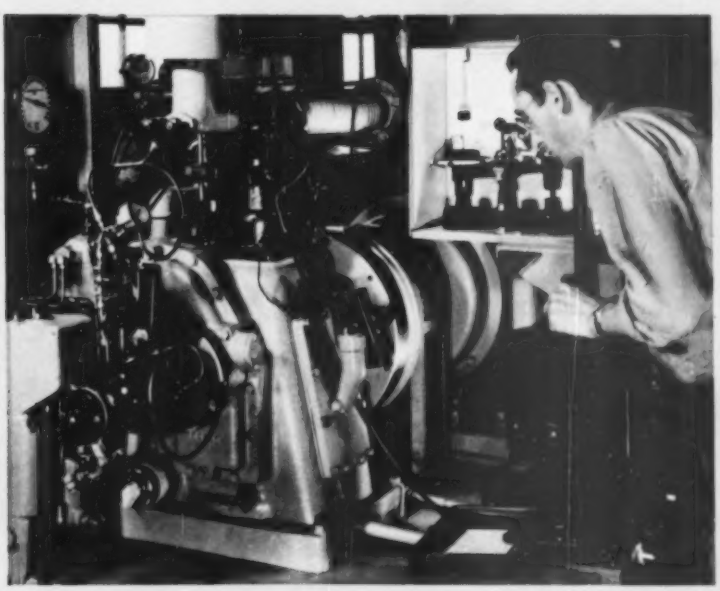
PLUS *a Long-Range Research Program to Help You Meet Changing Fuel Requirements*

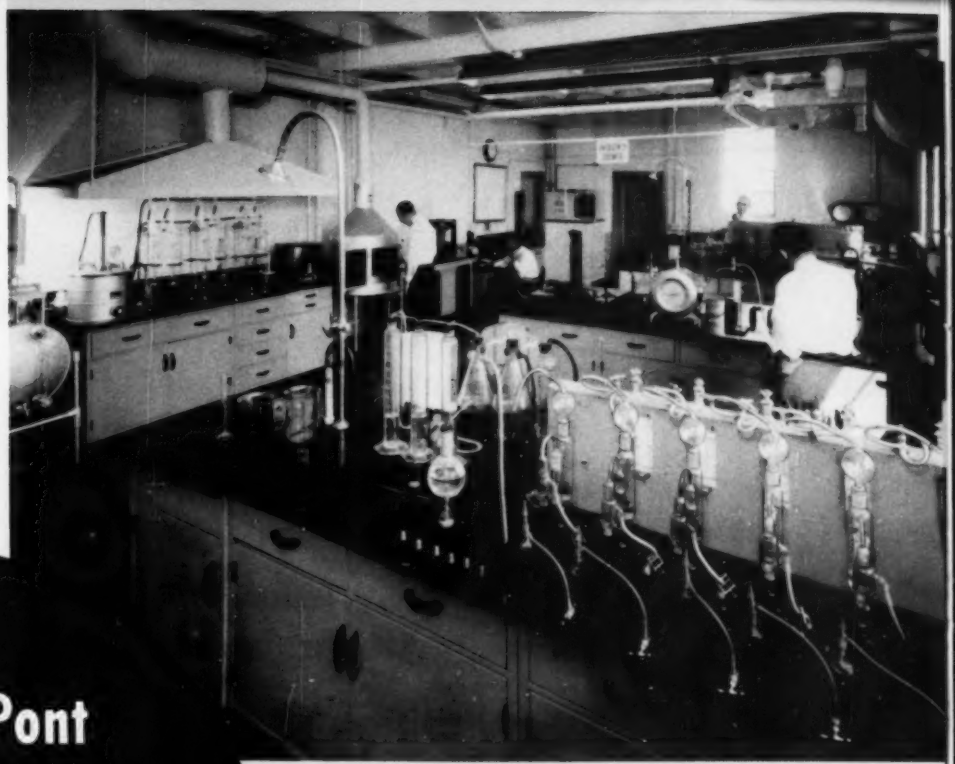
The development of new engines brings changes in fuel requirements. Likewise, changes in refining methods or sources of crude create differences in the basic characteristics of fuels. These and many additional factors affect the requirements placed on additives.

It is to help you meet these changing requirements that Du Pont is now engaged in a long-range program of Petroleum Chemicals research. This program is aimed at the improvement of present antiknock agents and other additives and the development of new ones to meet the higher performance standards which the future is sure to bring.

Supplementing the work of the Petroleum Chemicals Division laboratories is the Company-wide program of fundamental and applied chemical research, the results of which are constantly examined for application to Industry requirements.

Thus, Du Pont research is at work today to help you create better fuels—now and in the future.





Chemical section of a District Laboratory. Also equipped to make octane determinations, they render many helpful services in the use of all Du Pont additives.

Make Du Pont the Source for all of your Gasoline Additives

● Du Pont offers you one dependable source of supply for all of your gasoline additives. This complete line includes Gasoline Antioxidants, Metal Deactivator and Gasoline Dyes, as well as Tetraethyl Lead Compounds. These additives have been proved by many years use in the field. They are compatible with each other and are of uniform high quality. The Du Pont District Laboratory in your territory will be glad to assist you in evaluating these additives in your fuel and to make the proper recommendations.

E. I. DU PONT DE NEMOURS & COMPANY (INC.)
PETROLEUM CHEMICALS DIVISION
Wilmington 98, Delaware

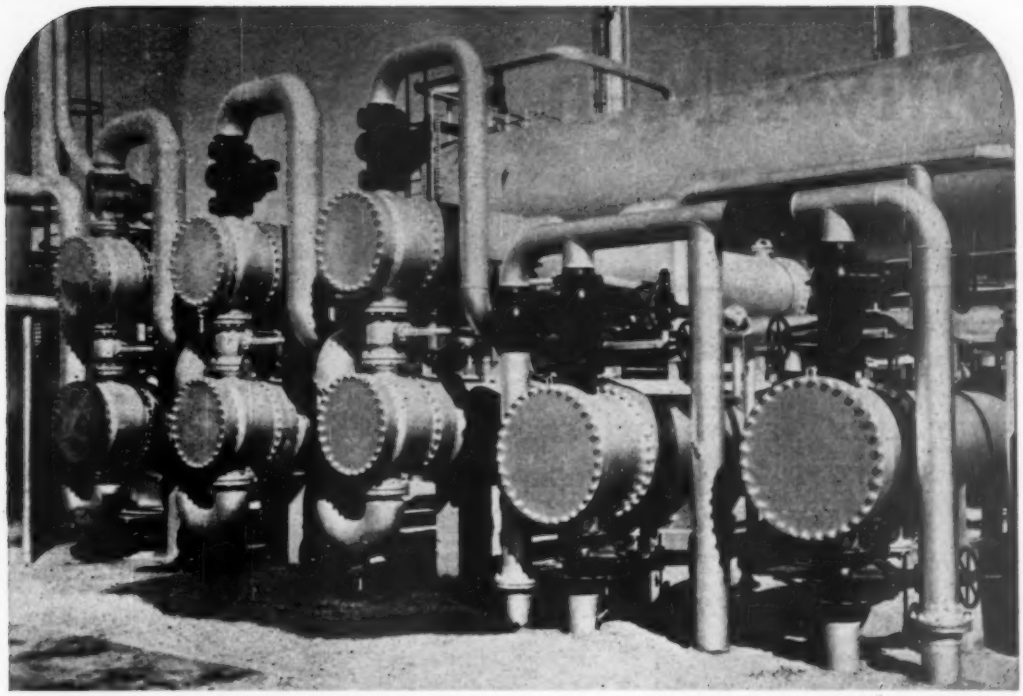
District Laboratories:	Wilmington, Del. Chicago, Ill. Tulsa, Okla. Houston, Texas El Monte, Calif.	*District Offices:*	Wilmington, Del. Chicago, Ill. Tulsa, Okla. Houston, Texas Los Angeles, Calif.

DU PONT
REG. U. S. PAT. OFF.
BETTER THINGS FOR BETTER LIVING
. . . THROUGH CHEMISTRY

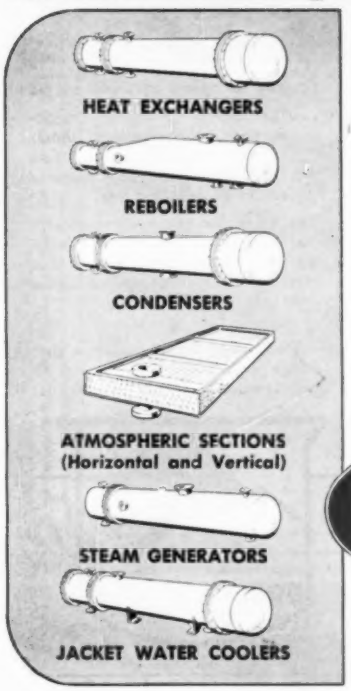
Antioxidants • Dyes

Tetraethyl Lead Compounds—Aviation Mix—Motor Mix

Metal Deactivator



Make sure your Heat Exchangers are



"EFCO Engineered"

● Heat exchangers by EFCO specialists are carefully designed to meet *your* specific requirements. EFCO heat exchangers give you long, trouble-free operation plus the extra advantages of lasting tightness, optimum heat exchange, and minimum maintenance costs.

ENGINEERS & FABRICATORS, INC.
P. O. Box 7395 Houston 8, Texas

EFCO HEAT TRANSFER EQUIPMENT

Only 4 Men on His Payroll—

JAMES RAYMOND
Raymond's Service Station
Stamford, Conn.

BUT JAMES RAYMOND HAS OVER 1,000 SCIENTISTS AND TECHNICIANS WORKING FOR HIM— ASSURING HIM QUALITY PRODUCTS— BUILDING YOUR CONFIDENCE IN HIM!

COMPLETE research facilities are only a part of the *great Flying Red Horse team* that contributes to the success of James Raymond and 46,000 Mobilgas dealers and jobbers like him.

The *high quality* of the products *you* buy . . . the *low price* you pay . . . *the very things that create opportunity and build business* for these thousands of independent businessmen . . . are results of integrated operation like this:

. . . Socony-Vacuum scientists constantly prospecting for new oil reserves

. . . fast tankers transporting oil from *field* to *refinery* to *dealer* to *you*

. . . the efficient, co-ordinated hook-up of oil fields, pipelines, laboratories, refineries, and distribution facilities—*making shortcuts and savings* all down the line!

That's the kind of *competitive efficiency* that helps James Raymond to build his own successful business—that gives him the advantage of *bigness* right in his own home town.

★ ★ ★

That's the kind of teamwork that makes possible *a big money's-worth for you*—at a small profit per gallon for us!

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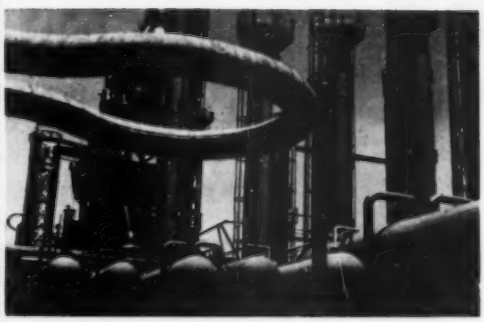
MAGNOLIA PETROLEUM COMPANY, GENERAL PETROLEUM CORP.

1,400 INDEPENDENT JOBBERS— 45,000 INDEPENDENT DEALERS—

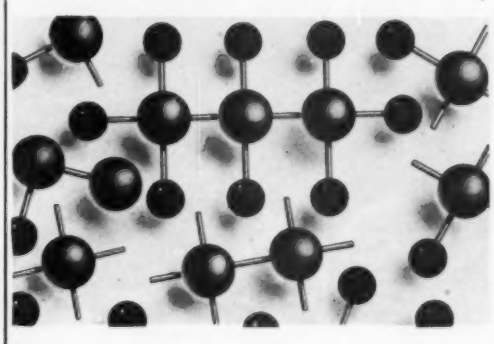
Rely on the Flying Red Horse for <u>What</u> <u>You</u> <u>Want!</u>

SOCONY-VACUUM

WE provide trained, experienced personnel . . .



to conceive, plan and build plants . . .



which do your bidding accurately, efficiently —profitably!

Engineering and Construction Division

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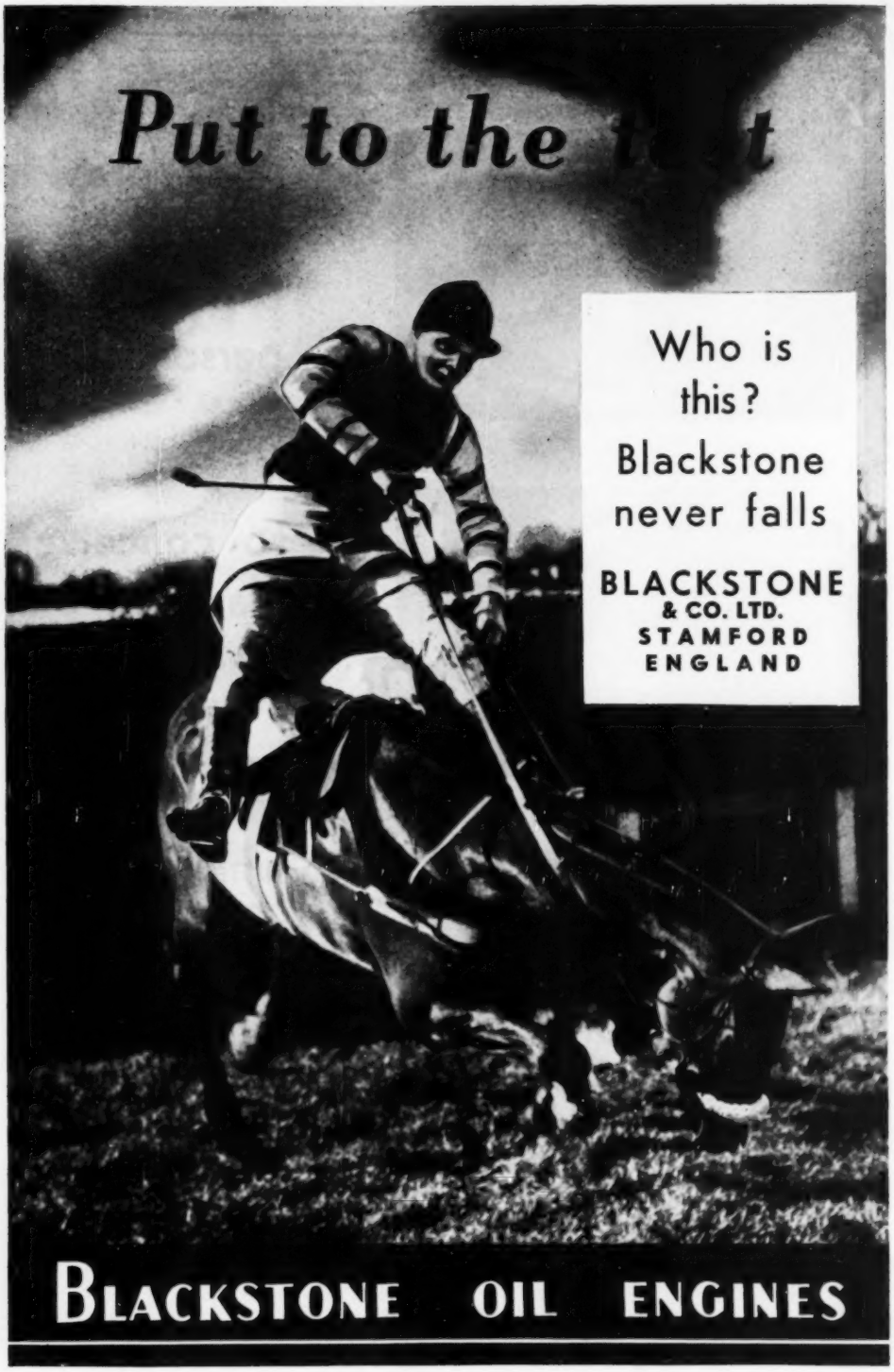
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Who is this?
Blackstone never falls
BLACKSTONE
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BLACKSTONE OIL ENGINES

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CHLORINE
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SODIUM BICARBONATE
CALCIUM CHLORIDE
CAUSTIC ASH
MODIFIED SODAS
SODA BRIQUETTES
(Iron Desulphuriser)
PHOSFLAKE
(Bottle Washer)
SILENE EF
(Hydrated Calcium Silicate)
CALCENE T
(Precipitated Calcium Carbonate)
PITTCHLOR
(High Test Calcium Hypochlorite)
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(Special Calcium Hypochlorite)
BORAX
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Good from any viewpoint

FROM THAT OF YOUR MANAGEMENT—
Columbia policies foster profitable business relationships.

FROM THAT OF YOUR TECHNICAL STAFF—
Columbia manufacturing controls eliminate production difficulties arising out of variances in quality and grading.

FROM THAT OF YOUR PURCHASING DEPARTMENT—
Columbia plant locations and expeditious handling of your inquiries and orders assure fast service.

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Yes, from any viewpoint, Columbia offers definite advantages as your source of supply for alkalies, chlorine and related chemical specialties. Pittsburgh Plate Glass Company, Columbia Chemical Division, Fifth at Bellefield, Pittsburgh 13, Pa.

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HEAT INSULATION *for all plants . . .*

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Planned HEAT INSULATION

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American engineering practice

in Britain

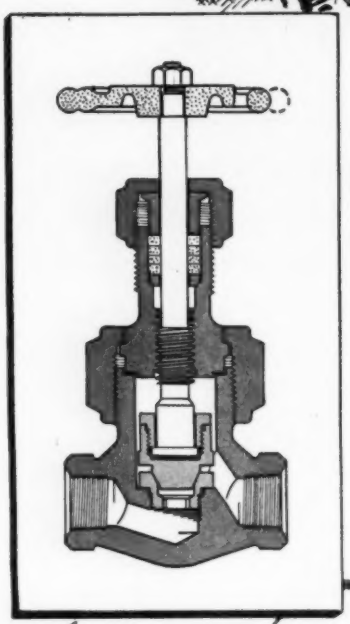
HEAD WRIGHTSON PROCESSES LIMITED are Accredited Engineers for Leading American Refinery Processes including Thermal and Catalytic Cracking and Reforming, Solvent Extraction and Dewaxing, Desulphurisation, Chemical Treating, Continuous Charcoal Adsorption, etc. . . . All plants engineered in strict accordance with American practice, and to American Codes. . . . Eighteen plants, including some of the largest Solvent Extraction Plants in the World, and the first large scale Carbon Black factory outside the U. S. A., all engineered by Head Wrightson Processes Ltd., are now in course of construction. Our services comprise engineering, purchasing, progressing, inspection, shipping, and supervision of erection.

Head Wrightson Processes Ltd.

TEESDALE HOUSE 24-26 BALTIC STREET LONDON E.C.1

"We need 300# Globe Valves that we can install and forget..."

"Okeh... specify VOGT Series 3430"*

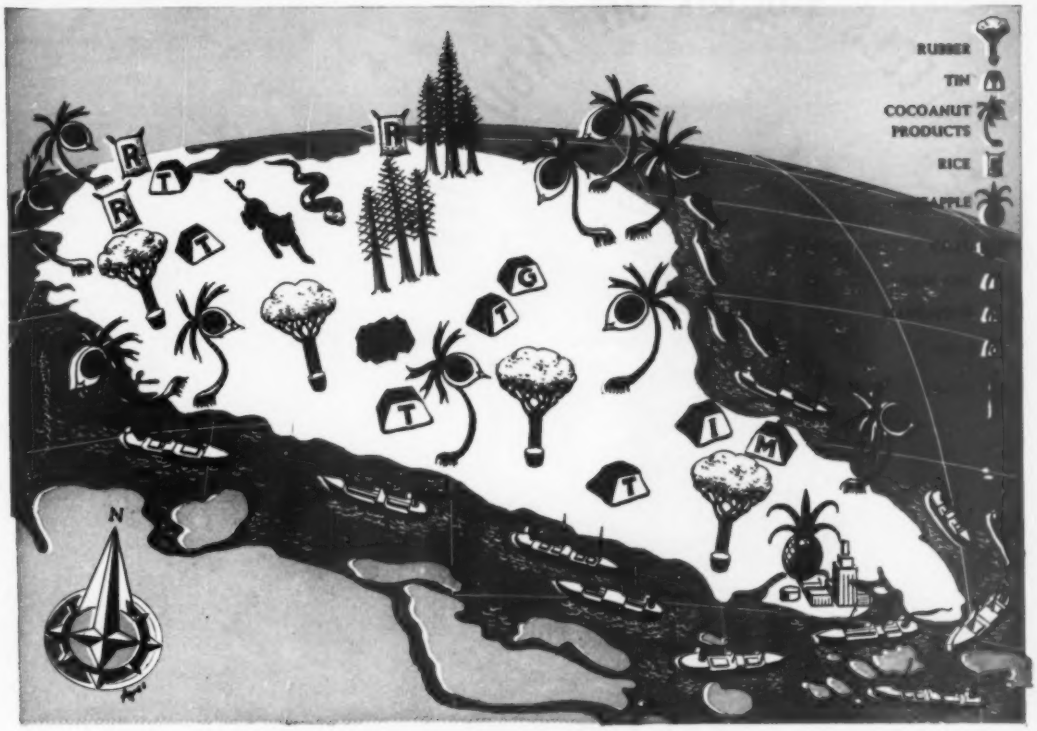


Sturdy drop forged steel valves like these won't let you down. They stay in there pitching year after year on your really tough jobs. Series 3430 valves have drop forged steel bodies and bonnets, 11½-13% chrome stainless steel seats and cone type loose discs. A flat gasket seals the male and female bonnet joint. The stuffing box can be repacked under pressure when the valve is fully open. These valves are also available with 18-8 stainless steel trimmings.

*Series 3430
CARBON STEEL { 300 Pounds @ 750° F. / 600 Pounds Cold Non-Shock
For 150-300 pounds general service Union Bonnet • Gasket Joint • Inside Screw Stem • Renewable Seat • 11½-13% Chrome Stainless Steel Trimmings Sizes ¼" to 2" inclusive.

HENRY VOGT MACHINE CO.
Louisville 10, Ky.
BRANCH OFFICES: NEW YORK • PHILADELPHIA CLEVELAND • CHICAGO • ST. LOUIS • DALLAS

Vogt DROP FORGED STEEL VALVES

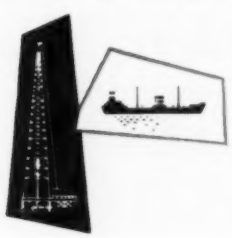


MALAYA

MALAYA . . . The tropical Malay peninsula and adjacent islands, comprising The Colony of Singapore and The Federation of Malaya, is amazingly colorful, enchanting, and productive. Its green jungle-clad mountains, rubber plantations and rich alluvial plains provide a large share of the world's rubber and tin; its natural wealth includes cocoanut products, rice, pineapple, timber, coal, iron ore, manganese and gold; its surrounding blue seas abound with fish. Living in friendly harmony with the hospitable Malays in this equatorial clime are Chinese, Indians, Burmese, Siamese, Indonesians and Occidentals from many countries.

SINGAPORE, the focal point of the verdant peninsula, with its teeming harbor rated among the world's ten most important, is truly the "Crossroads of the East." Through this great clearing house of Southeast Asia flows commerce in endless variety.

STANDARD-VACUUM is proud of the part it plays in supplying Malaya with the petroleum products so essential to its welfare and continued growth.



STANDARD-VACUUM OIL COMPANY

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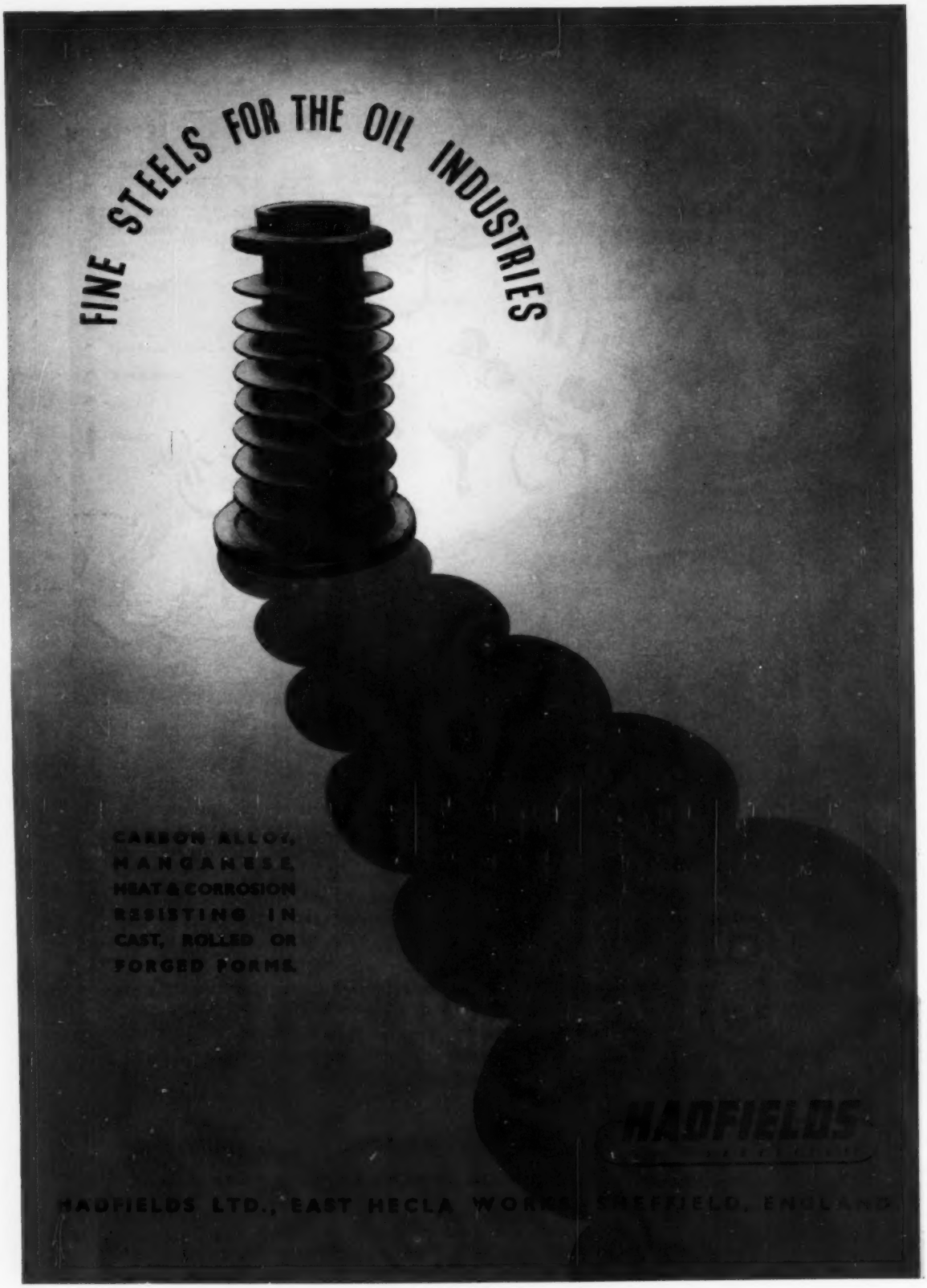
AUSTRALIA • BURMA • CEYLON • CHINA • INDIA • INDO-CHINA • JAPAN • KENYA
MADAGASCAR • MALAYA • MAURITIUS • INDONESIA • NEW ZEALAND
PAKISTAN • PHILIPPINES • PORTUGUESE EAST AFRICA • RHODESIA • SIAM
SOUTH PACIFIC ISLANDS • SOUTH-WEST AFRICA • TANGANYIKA • UNION OF SOUTH AFRICA

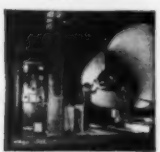

FINE STEELS FOR THE OIL INDUSTRIES
CARBON ALLOY, MANGANESE, HEAT & CORROSION RESISTING IN CAST, ROLLED OR FORGED FORMS.
HADFIELDS
HADFIELDS LTD., EAST HECLA WORKS, SHEFFIELD, ENGLAND

Metallurgical Research conducted continually by recognized specialists who have made major contributions in this field.

Unique Technical Backing of an extensive organization with an international reputation in both process and fabrication engineering.

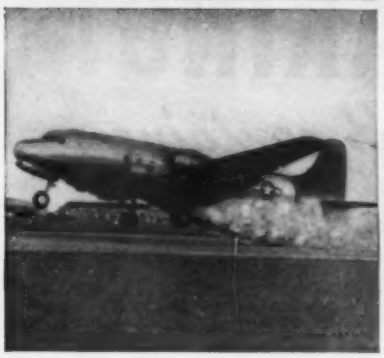
Complete Facilities for the fabrication of steel products from simple forgings to the most intricate 120 foot towers.

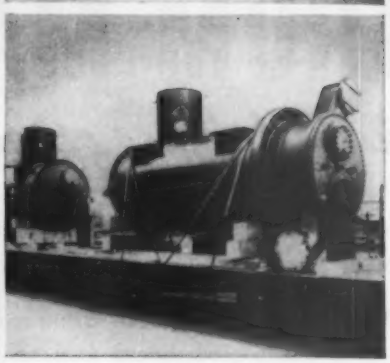
Top Welding Performance assured by specially designed equipment and exclusive employment of master operators.



Quality Control embracing the constant application of the most advanced inspection methods, both visual and non-destructive.

On-Time Delivery made possible by a flexible planning group authorized to re-route work to meet promised dates.





What do these four have in common?

IT is the common denominator of this broad grouping that means something to you—the problem of heat exchange under varying conditions.

Take the Oak Ridge job. It was colossal in size and concept. But it was also outstanding because it included both processing of one of the most corrosive agents known (uranium hexafluoride) and the elimination of any possibility for contamination of the product. Kellex—Kellogg subsidiary—designed the heat exchangers.

What about rocket engines? Operating temperatures up to 6000°F in the combustion chamber with the concurrent limitation of the radically lower temperatures that both containing metals and volatile coolants can withstand, *plus* minimum weight requirements, *plus* use of highly corrosive cooling substances . . . those "specs" truly add up to a major heat exchange problem. Kellogg continues to design and fabricate these newest power units.

You, of course, are familiar with refinery heat exchange requirements: high throughput and low maintenance. The requirements for marine condensers are also exacting in that breakdowns while in use cannot be tolerated. Kellogg fabricates these types by the shipload.

Next time you are ordering heat exchangers remember that Kellogg is one place in the country where you can get all this design and fabricating experience, in the field of heat exchange, *under one roof*. And remember too that Kellogg is continuing its exploratory work in atomic energy . . . expanding rapidly in the field of jet propulsion . . . continuing to improve its refinery exchangers . . . working on other types—all with the goal of lower costs, lower maintenance and higher efficiencies.

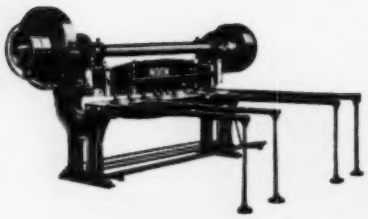
To master temperature, pressure and chemicals use

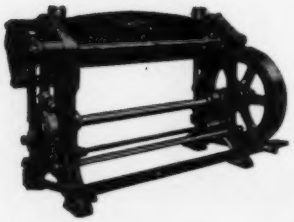
M. W. KELLOGG

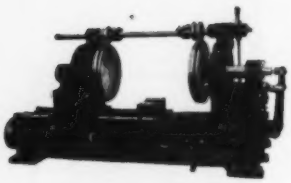
process equipment

VESSELS • EXCHANGERS • CONDENSERS • HIGH PRESSURE AND HIGH TEMPERATURE POWER PIPING PROCESS PIPING • FORGED AND WELDED FITTINGS . . . IN ALL STEELS, ALLOYS OR SPECIAL COMBINATIONS

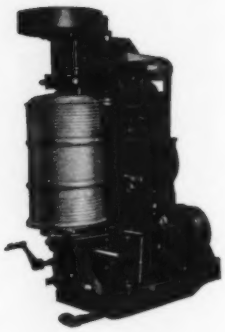
The M. W. Kellogg Company, Inc. (A Subsidiary of Pullman, Inc.) — Offices in New York, Jersey City, Buffalo, Los Angeles, Tulsa, Houston, Toronto, London and Paris.





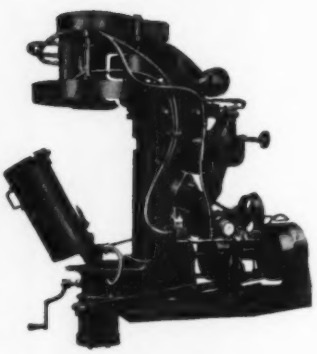


The team to back for
DRUM MAKING!
and all types of oil containers



For the large producer, a complete drum making plant by MOON can end a lot of worries.

We have installed these drum-making teams in various parts of the world, and they win both at home and away. They are designed from a unique and highly specialized experience of the needs of the job, and incorporate every desirable feature.



If you are interested in making smaller containers remember, MOON make a machine for every operation in metal containers and tin box manufacture. Our advice is freely at your disposal. Write to us!

MOON

Regd. Trade Mark

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BEAUFORT ROAD BIRKENHEAD ENGLAND

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Cables: "Moonbro," Birkenhead England.

Makers of Tin Box and Drum Making Machinery

dm MB 12

UNIVERSAL PETROLEUM COMPANY

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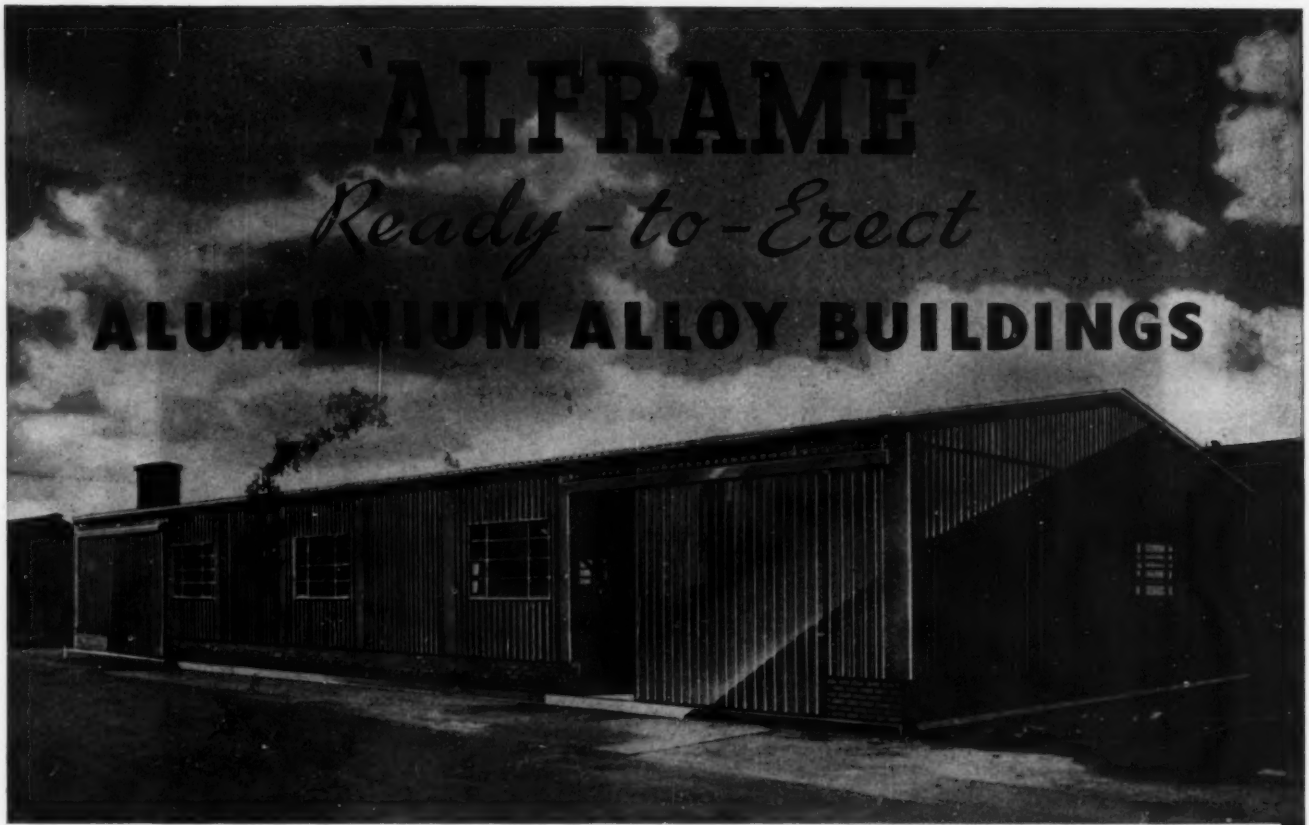
Producers and UNIGAS UNIFUELS UNITHEN *Marketers of Petroleum Products*

NATIONAL BANK OF TULSA BUILDING
TULSA, OKLAHOMA



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RAPID ERECTION · CLEAR FLOOR SPACE
ANY LEVELLED SITE

The "Alframe" provides factory made buildings of standard components of aluminium alloy, easily transported by road or rail. The standard 9 ft. bays (36 ft. clear span) allow buildings of any length to be erected at will. The complete absence of internal supports provides an entirely clear floor area. A standard "Alframe" 72 ft. x 36 ft. can be erected in 24 hours. "Alframes" require no painting or other weather protection and are especially suitable for use in hot climates.

"Alframes" are in use for factories, workshops, storage buildings etc. in many countries. Full information will be sent on request.

"Alframe" buildings have been supplied to many well known firms including Overseas Food Corporation, The Anglo-Iranian Oil Company, Kuwait Oil Company, Thomas Lipton Ltd. Ministry of Agriculture.

The building is erected entirely by hand.

Interior of typical Alframe building.

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BUILDINGS CAN BE DELIVERED IN THREE MONTHS OF ORDER
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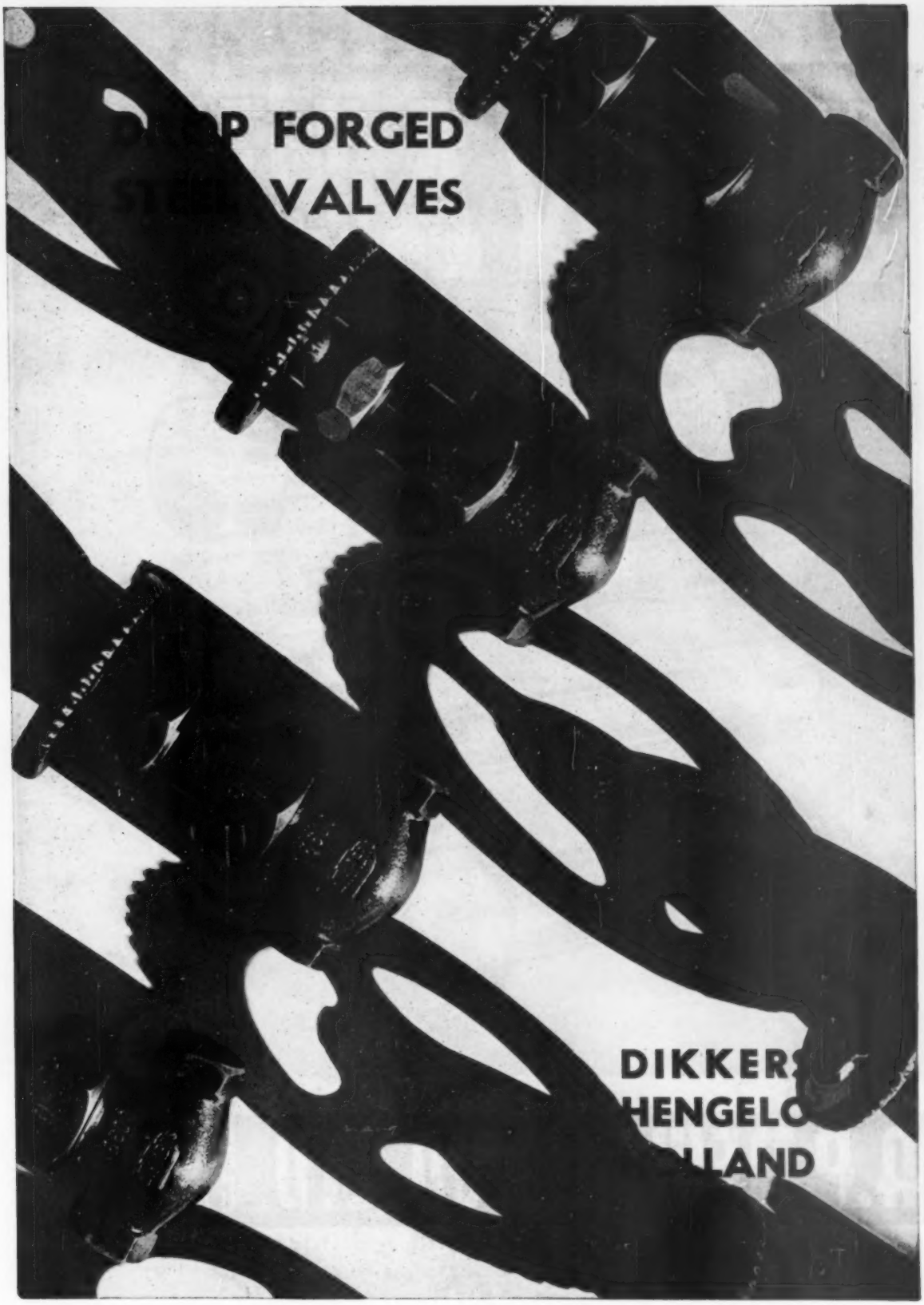
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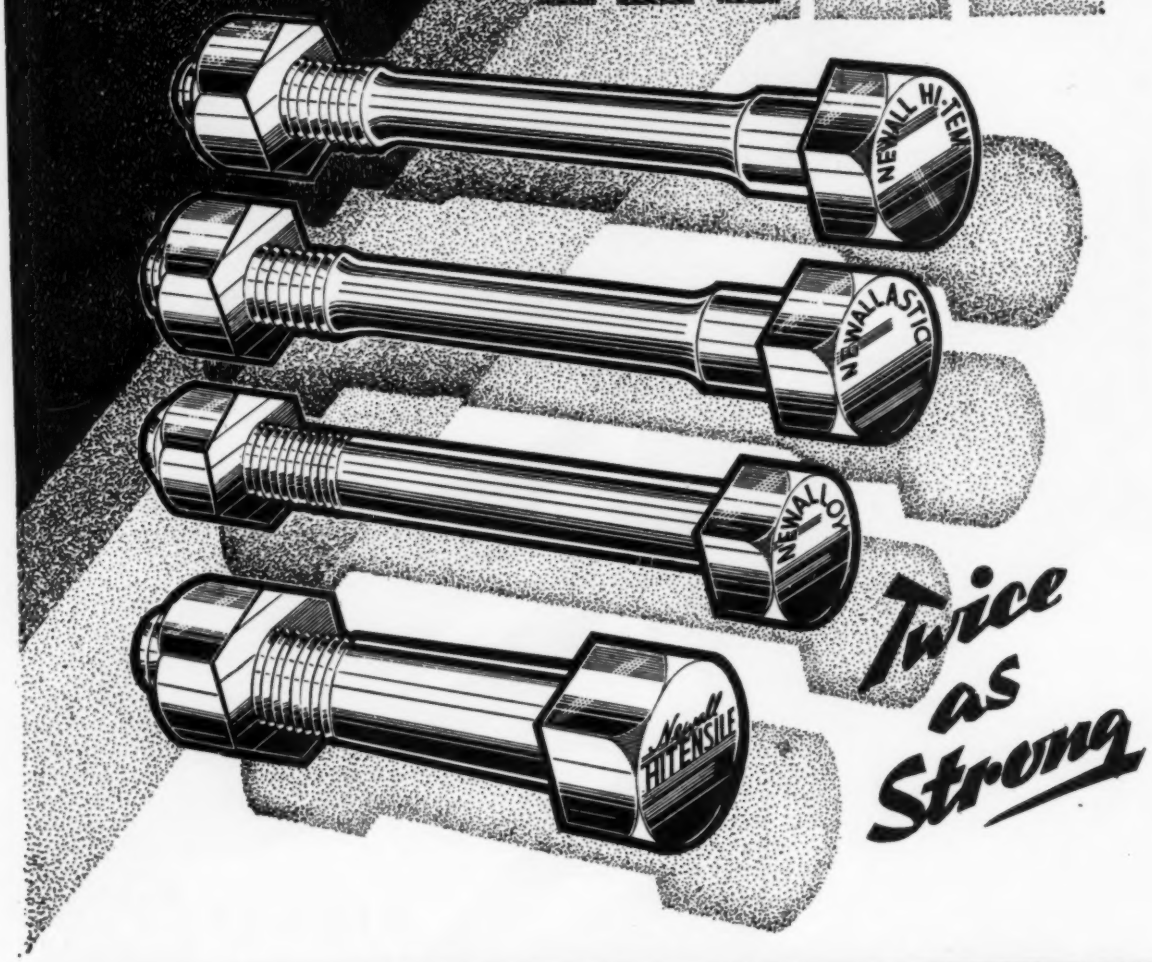

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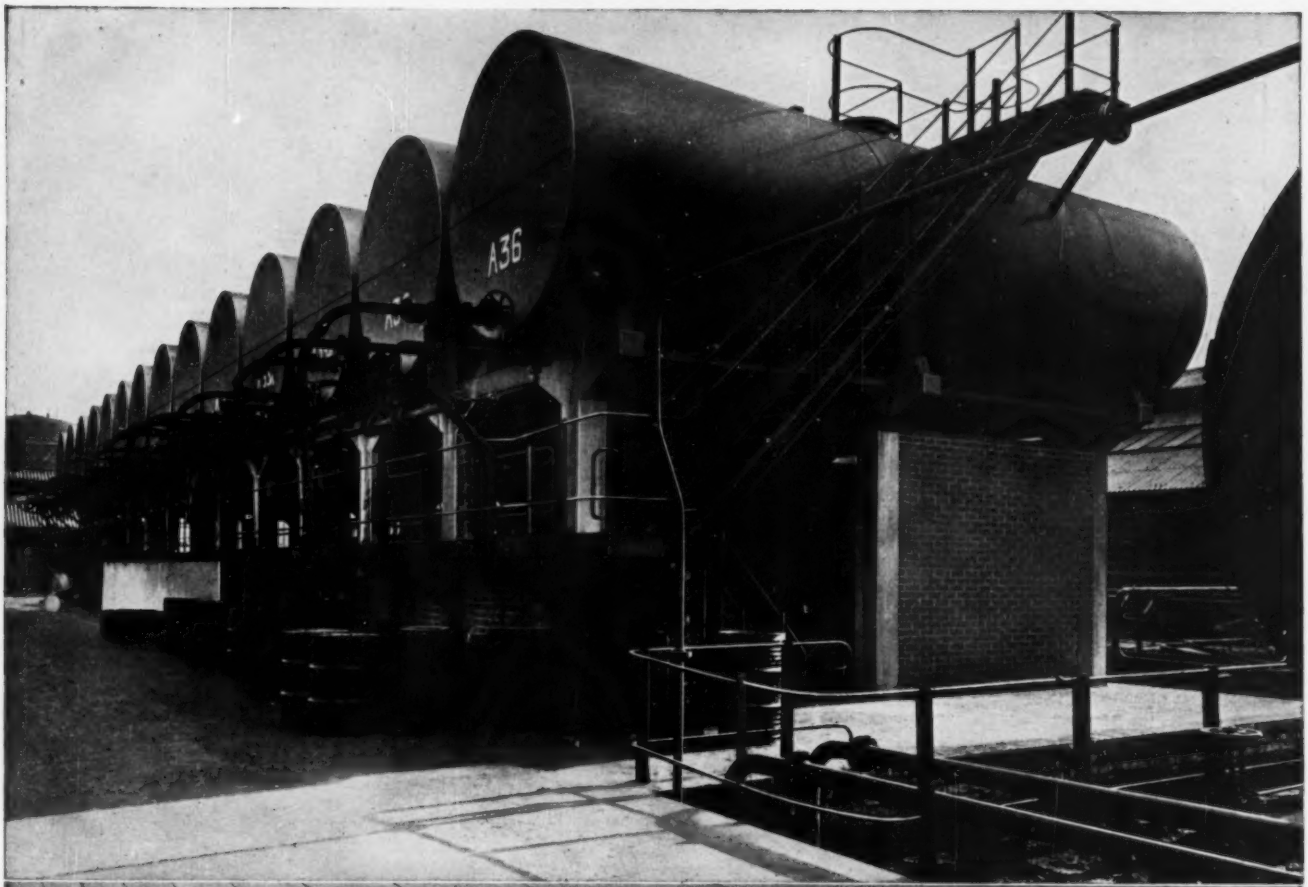

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WELDED STORAGE TANKS

A close-up view of a battery of fourteen welded storage tanks each 9'0" diameter by 30'0" long with connecting platforms and access staircases.

Erected and installed by Oxley at Ellesmere Port, Cheshire, England, for Lobitos Oilfields Ltd., who gave permission for this photograph to be taken.

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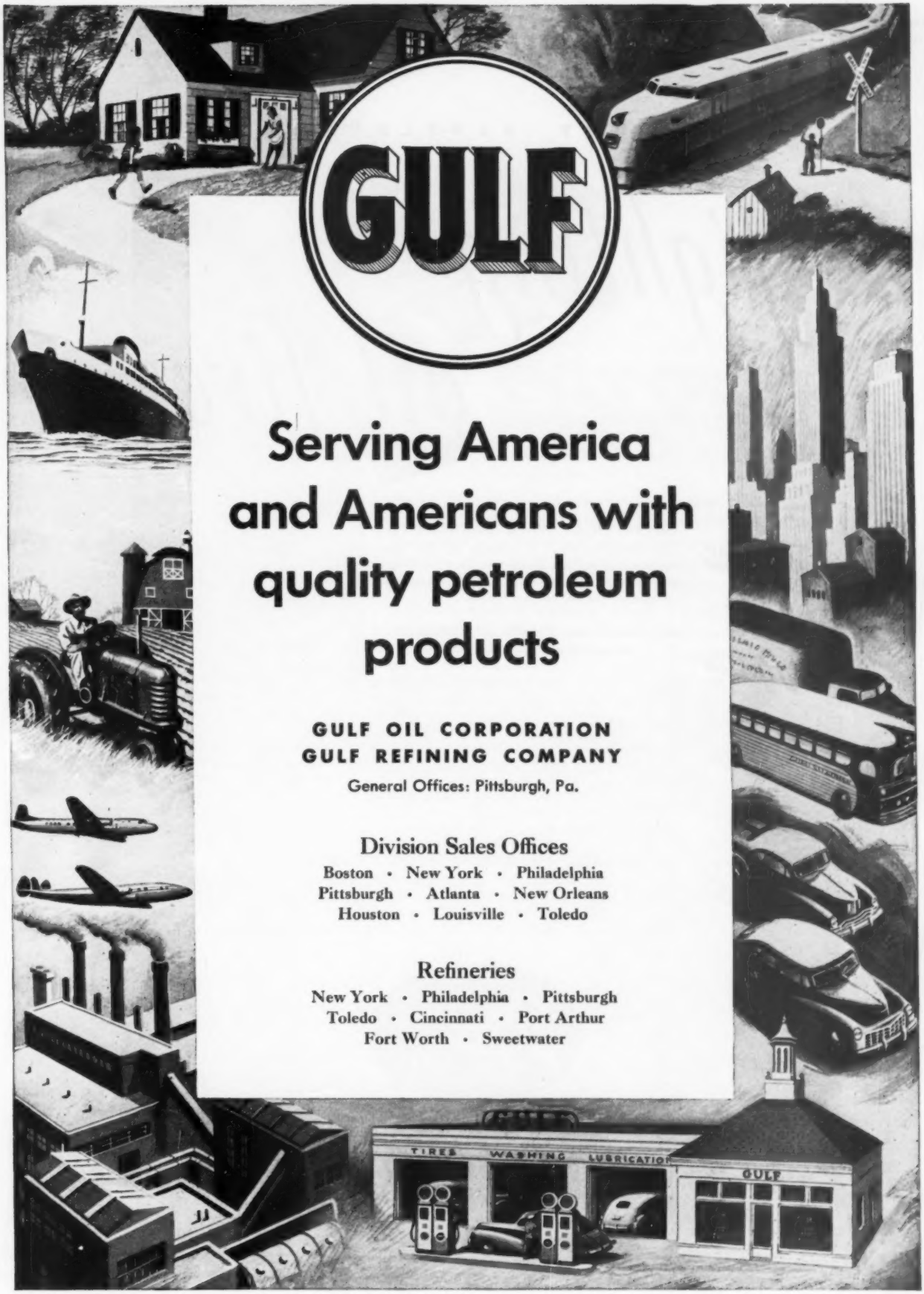

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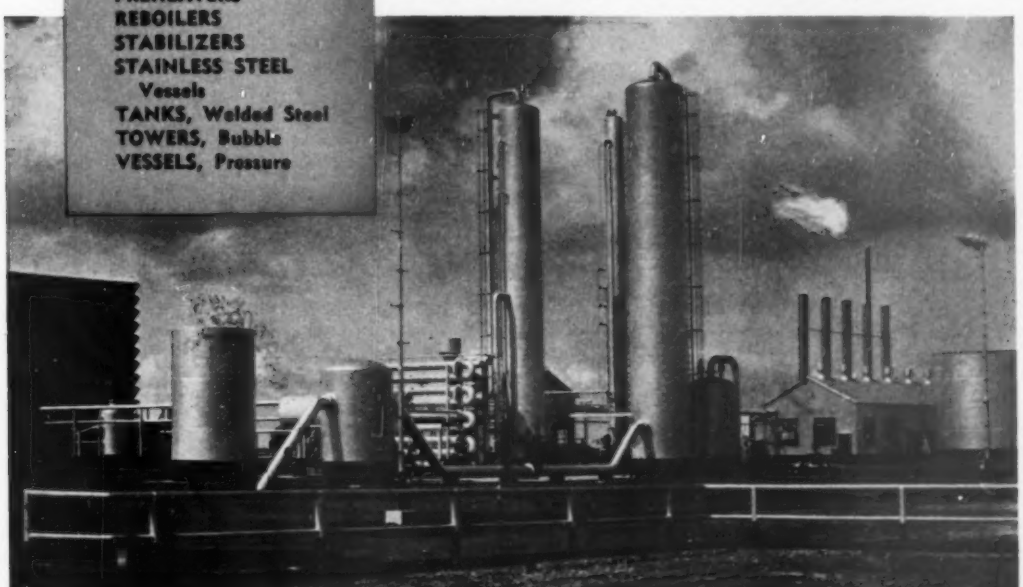

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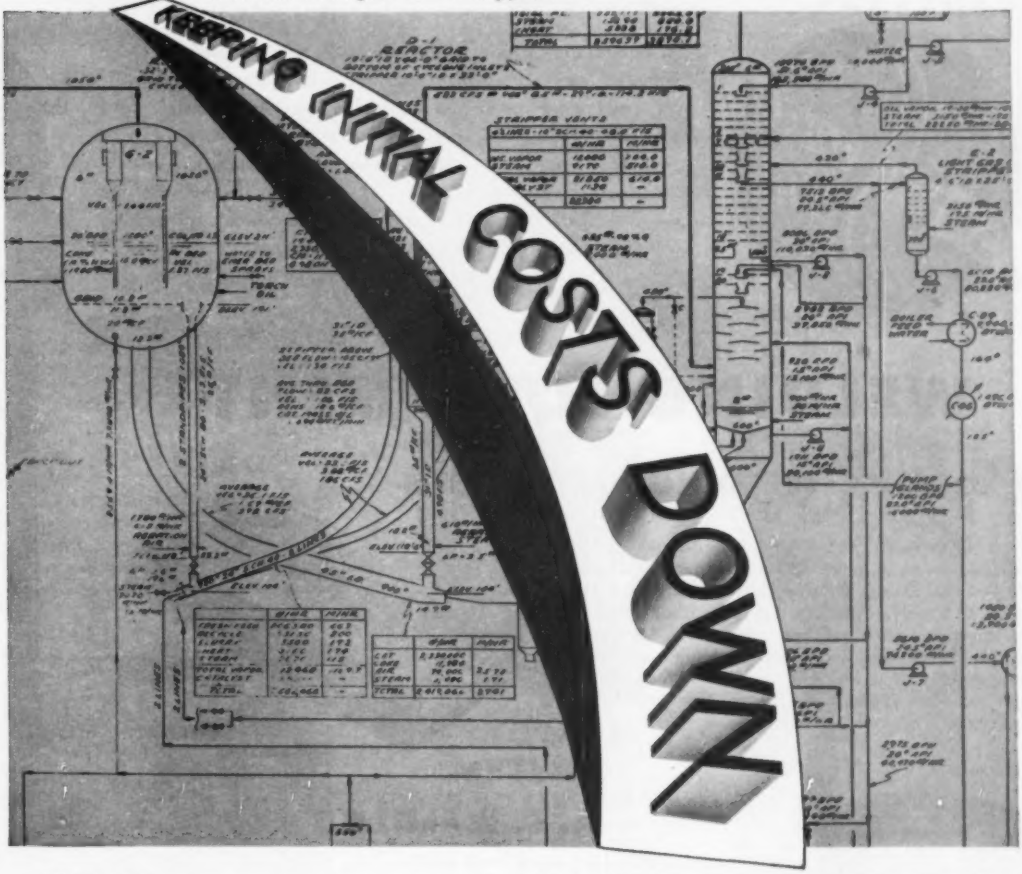
N.B. While it is axiomatic that return on investment—the *ultimate earning power* of a refinery unit when actually on stream—is the only true evaluation of competitive engineering recommendations, initial plant costs remain a major factor in refiners' decisions on plant installations. M. W. Kellogg takes specific steps to *minimize initial plant costs* consistent with the achievement of *highest ultimate earning power.*



KELLOGG starts to keep costs down at the precise point where a refinery project starts . . . in process design. For it is the quality of work in the design phase that establishes not only the ultimate earning potential of the unit but also the framework on which initial costs are predicated.

Quality of process engineering is, of course, dependent on the relative ability of individual engineers, their resources in data and experience, the emphasis put on process design by management . . . and, in the final analysis, on the organizational set-up within which the engineers work. Beyond the marked advantages Kellogg can show on the first three factors, its organizational set-up definitely assures *superior quality* in process engineering.

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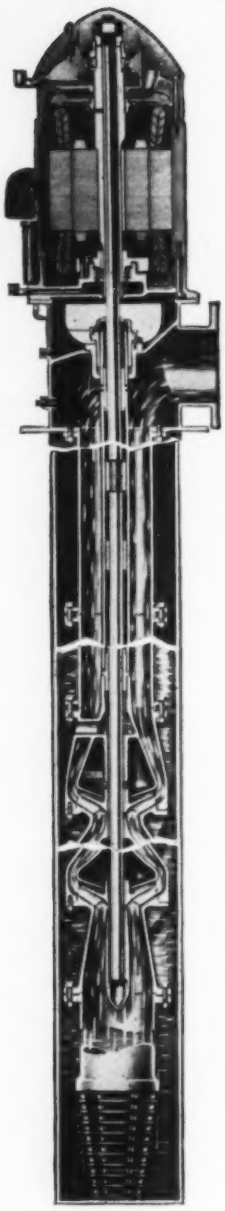

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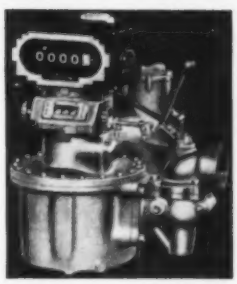

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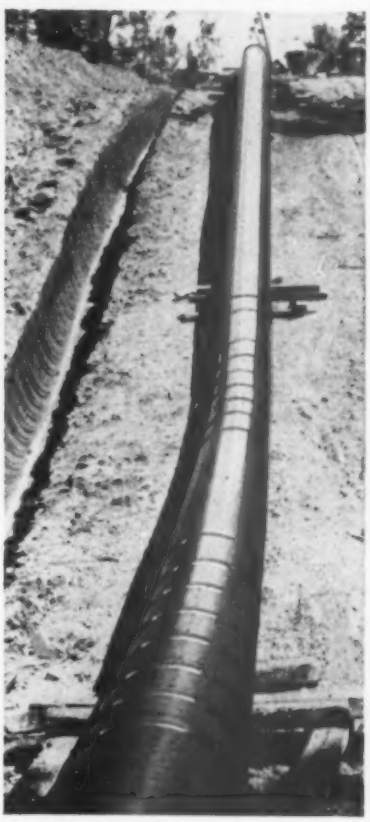

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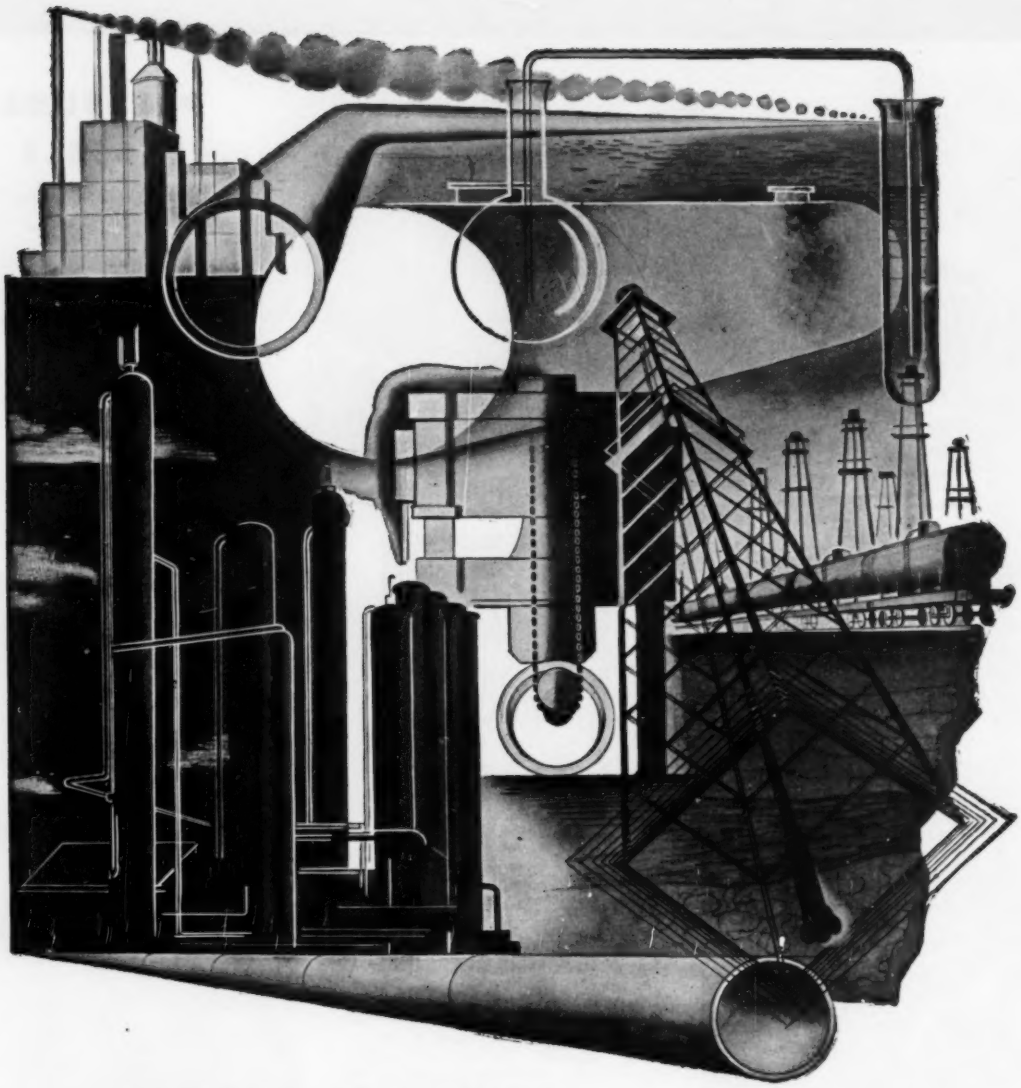

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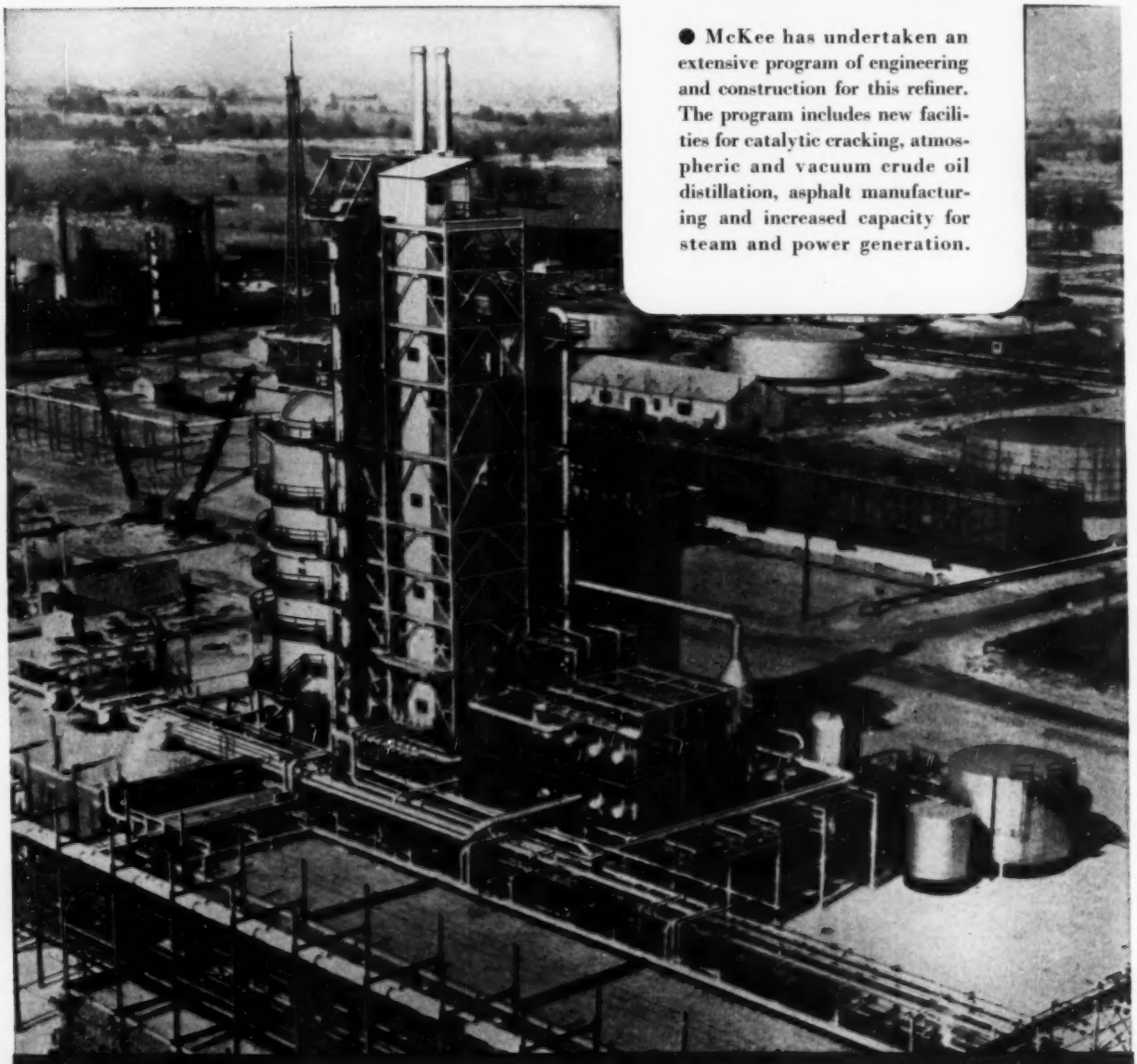

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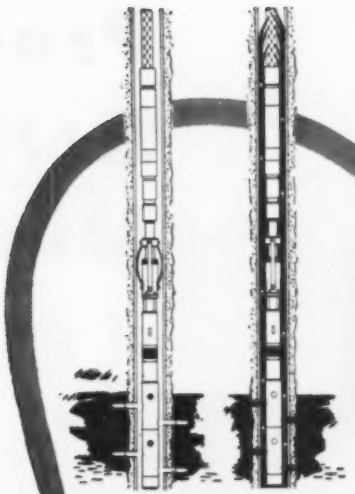

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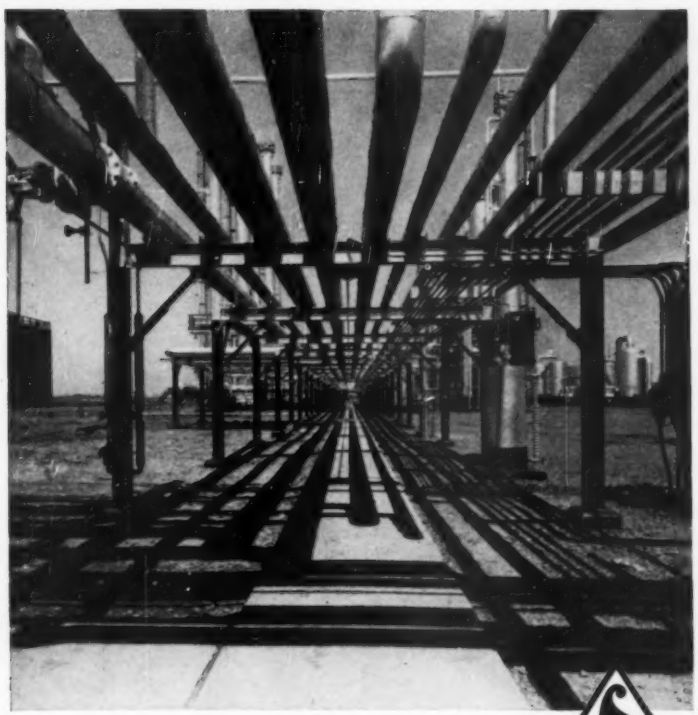

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Three Views of a New Refinery

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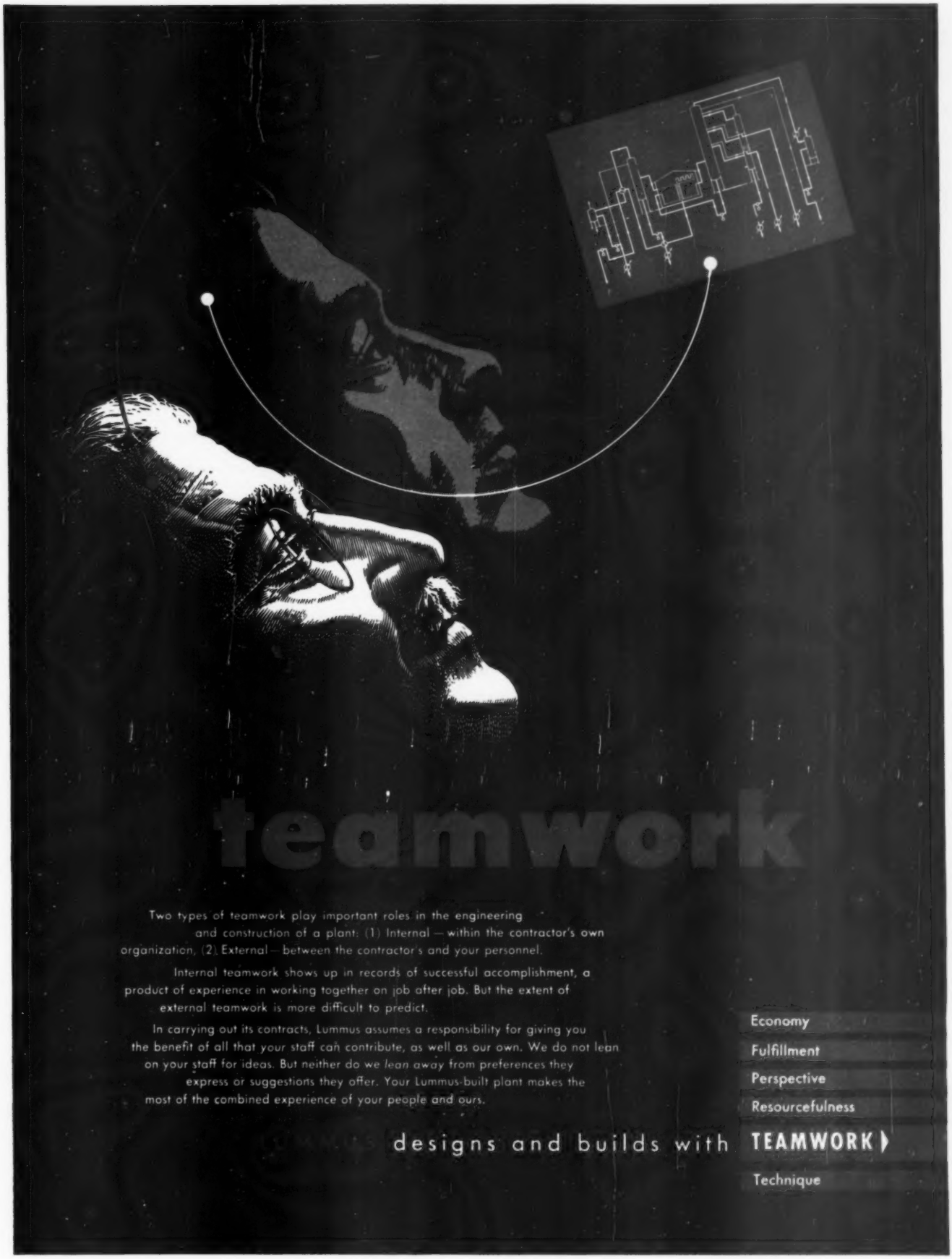
STANDARD OIL COMPANY (NEW JERSEY)
AND AFFILIATED COMPANIES



Two types of teamwork play important roles in the engineering and construction of a plant: (1) Internal — within the contractor's own organization, (2) External — between the contractor's and your personnel.

Internal teamwork shows up in records of successful accomplishment, a product of experience in working together on job after job. But the extent of external teamwork is more difficult to predict.

In carrying out its contracts, Lummus assumes a responsibility for giving you the benefit of all that your staff can contribute, as well as our own. We do not lean on your staff for ideas. But neither do we *lean away* from preferences they express or suggestions they offer. Your Lummus-built plant makes the most of the combined experience of your people and ours.

designs and builds with **TEAMWORK**

Economy
Fulfillment
Perspective
Resourcefulness
Technique

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In the development of improved methods of producing lubricating oil, Lummus has worked in close-knit cooperation with many leading oil companies. Lummus' exclusive pilot plant equipment for lube-oil process development has been employed to explore process alternatives suggested by these customers, supplementing their own research. More than 85 process units for solvent refining and dewaxing have resulted from this work — including the largest lube-oil plant in the world.

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teamwork in plant construction

Construction in foreign countries and remote locations calls for a close relationship at the site between Lummus' personnel and oil company field forces. Assignment of men with a thorough knowledge of the region, its customs, laws and labor regulations, helps maintain this local cooperation. Records are maintained in accordance with client requirements for progress reports and cost control.

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PUBLISHED BY MONA PALMER

THE MANAGEMENT PUBLICATION OF THE INTERNATIONAL PETROLEUM INDUSTRY

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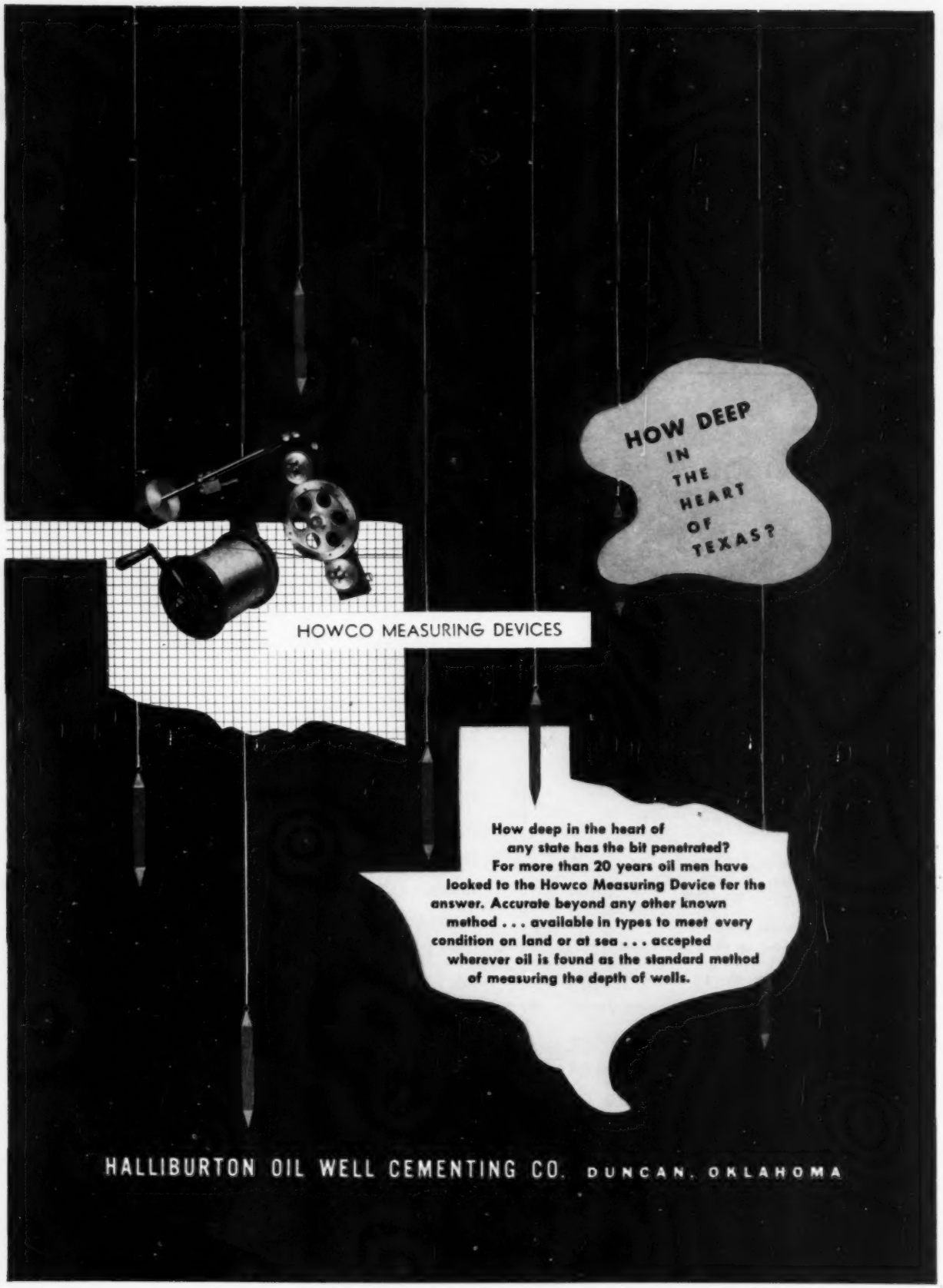
This Month's Cover

Pictured on the cover of this issue are two maintenance men at the Lake Charles, La., refinery of Cities Service Oil Co., engaged in overhauling one of the deep-well pumps which supply the plant with water. In addition to the water pumped from the nearby Calcasieu River for cooling, the group of plants at Lake Charles has 14 deep-well pumps like the one pictured. Four are at the Cities Service refinery, three at the new Cit-Con lube plant being built by Cities Service and Continental Oil Co., four at the butadiene plant, and three at the Firestone copolymer plant. Each pump is capable of lifting 1,500 gallons of water per minute from the 700-foot wells. Color photographs were taken for Cities Service by Fritz Henle and are reproduced here through the courtesy of the editors of *Service*, house magazine of Cities Service Oil Co.


HOW DEEP
IN
THE
HEART
OF
TEXAS?
HOWCO MEASURING DEVICES
How deep in the heart of
any state has the bit penetrated?
For more than 20 years oil men have
looked to the Howco Measuring Device for the
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EDITORIAL

REFINING TRENDS POSE INTERNATIONAL PROBLEM

AT mid-year 1949 the refining industry faces an interesting situation and one practically without precedent. In the United States, after being called upon to meet an unexpected rise in consumption, the industry acquitted itself so well that by the end of 1948 it not only had met every requirement put upon it but had built up an impressive margin of all product stocks.

Refiners have had to make some adjustments in their processing to fit consumer requirements. First the heavy demand for distillate fuels led to a concentration on these products at the expense of lighter elements. This shift was maintained through a good part of 1948 in the effort to provide an ample supply for the following winter which proved to be unusually mild, while at the same time slackening industrial activity led to an easing of fuel oil demand, with the result that at the close of the season during which consumption normally is at its highest, stocks were heavier than at any previous similar date.

On the other hand consumption of gasoline shows substantial gain during the early months of 1949 with a much larger number of relatively new cars on the roads, and indications are that this growth will be sustained throughout the year. Early surveys point to an increase of 10 percent or more in vacation motor travel over 1948. This has made it possible for refiners to raise the ratio of gasoline production to the extent that something over 44 percent of their runs are converted into motor fuel, or about the same proportion that prevailed directly preceding the war and fully three percent higher than at the time when the heaviest emphasis was placed on fuel oil production.

It might be said, therefore, that refining operations in the United States have returned very nearly to a normal peacetime basis. Refining capacity is ample to take care of current requirements, while steady improvement of processes and the extensive program of expanded facilities now under way will handle any growth in consumption likely to take place during the near future.

Elsewhere the current year is one of great activity in the refining industry. Reconstruction of war-damaged plants is now well advanced except in a few areas where disturbed conditions still prevail. A vigorous program of new construction has been put under way which will lead to successive completions during the next three years and will result by the end of that time in a remaking of the world map of refining and in a substantial realignment of international trade routes for oil.

With the economic advantage which they foresee in obtaining their oil supplies mainly from the Middle East, particularly after the completion of several large pipelines make these available on the eastern shore of the Mediterranean, and with the saving in exchange from importing crude rather than products, the countries of western Europe are engaging in an expansion of refining facilities which will substantially double their prewar capacity and will enable them severally to process their requirements of products and in some cases provide a surplus for export.

In South America a big increase is under way and planned in the number and size of refineries while in both the Near and Far East large plants are projected to serve the needs of markets in that half of the globe.

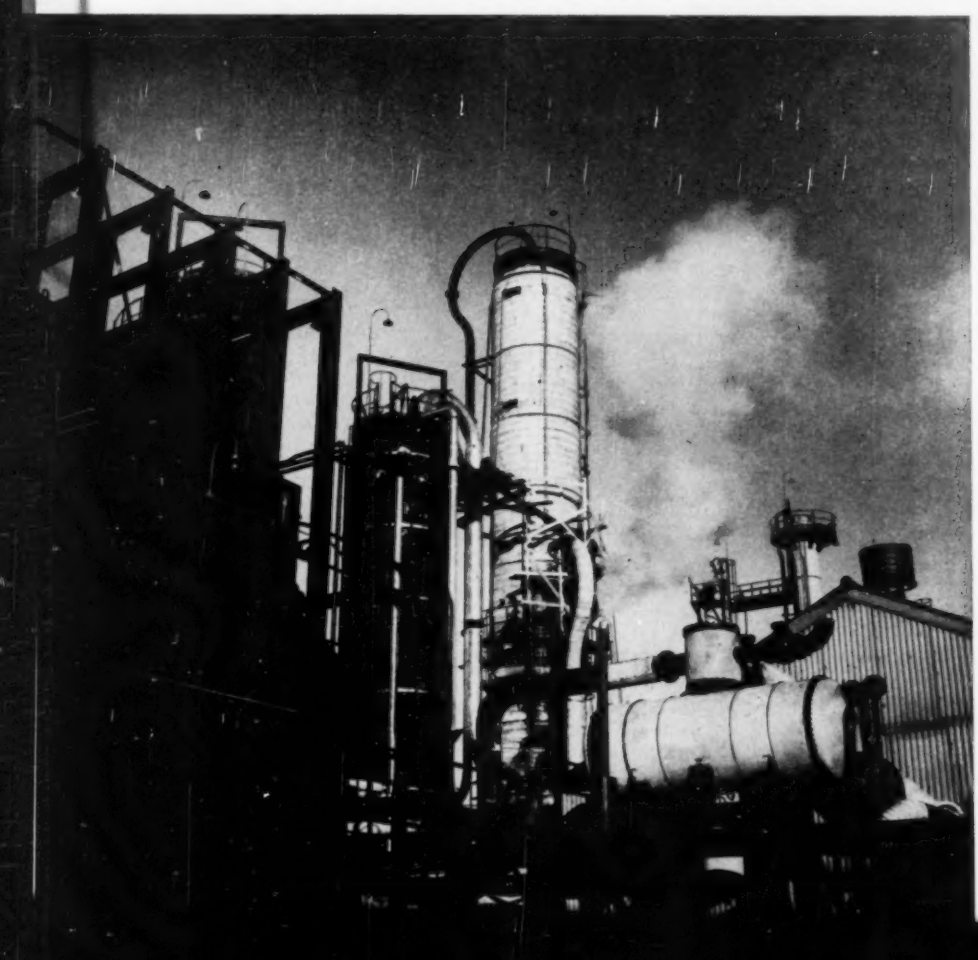
Taking into account only those plans for new construction and expansion which seem certain of being carried to completion, world refining capacity appears headed for the tremendous total of 12 million barrels daily by 1953. Whether consumption can expand sufficiently to keep facilities of such magnitude occupied will depend upon the rate of industrial recovery that can be attained in the meantime.

At the present time international trade in petroleum is affected and to some extent distorted by wide variations in the value and supply of currency with which to operate such trade. The United Kingdom, for example, is finding the oil production of countries within the sterling bloc a valuable prop in its efforts to attain a closer balance between income and expenditure and is seeking by trade agreements to extend its markets. Other countries are being forced by uneven distribution of exchange to reduce importations of dollar oil, while still others are seeking the same result by severe restrictions upon the use of petroleum products.

One purpose of the American government in entering upon the European Recovery Program and other similar undertakings was to promote a broader and freer interchange of commodities among nations. To accomplish this result requires a degree of cooperation which some countries find it difficult if not impossible to extend. Solution of this crisis, which now engages the efforts of government authorities, will determine the success or failure of the economic as distinct from the political phase of these plans and will decide whether international trade is to be conducted on the broad basis envisaged or is to become more completely compartmentalized than in the past.

WORLDWIDE REFINERY EXPANSION ASSUMES ADDED MOMENTUM

Cracking plant at the Imperial Oil Ltd. refinery at Edmonton, Alberta, moved from Alaska and reerected at Edmonton to process crude from newly discovered fields in the Canadian prairie provinces.



IN every quarter of the globe the current year is one of great activity in the elaboration of refining facilities. Rehabilitation of war damaged plants has made such progress that most of those capable of repair now equal or exceed their prewar throughput. New construction, hampered previously by governmental restrictions on the use of materials or by inability to obtain deliveries, is making good progress now that these conditions have eased. Completion of projects now under way will add a million barrels per day or more to the prewar capacity of plants outside the United States, while plans definitely approved for further building will greatly increase this growth in the course of the next two years.

In the western hemisphere intense activity in oil production has developed in Canada, opening a new and important chapter in petroleum development in that country. Successive discoveries of prolific fields during the past year in Alberta have led to a great increase in drilling operations and have stimulated interest in exploration in neighboring provinces. Wells completed up to this time have a potential productive capacity much above the current requirements of local areas, and as a result their output has had to be prorated to a very low rate. Refining capacity in the district was geared to the much smaller previous outturn and consequently is inadequate to handle the present growth in supply, while pipeline outlets also will be needed in order to reach wider markets.

Fortunately the Alberta refining situation has been helped during the past year by the opening of the refinery of Imperial Oil Ltd. at Edmonton. This plant was removed to its present site from its wartime location at Whitehorse, Yukon, and went on stream in June 1948 with a daily capacity of between 4,000 and 5,000 barrels. Installation of a new distillation unit this year together with other improvements has raised capacity to 15,000 barrels daily.

The only other refinery of like capacity in the prairie provinces is the Imperial plant at Regina, Saskatchewan. This was partially disabled by fire early in the year. In repairing the fire damage, improvements are being made to raise its capacity to 16,000 barrels per day.

Other major prairie refineries and approximate daily throughput are: Imperial Oil, 9,500 barrels, and British-American Oil, 6,000 barrels, both at Calgary; Gas and Oil Products, 4,000 barrels, at Turner Valley, Alberta; British-American, 5,500 barrels, at Moose Jaw, Sask., Consolidated Co-Operative, 2,200, Regina; Anglo-Canadian, 2,000, Brandon, Man.; North Star, 2,000, Winnipeg. Other smaller refineries on the prairies, each producing 400 or 500 barrels daily, are: Husky and Excelsior, both at Lloydminster on the Saskatchewan-Alberta border; Hiway at Rosetown and Saskatoon in Saskatchewan; Moose Jaw Refineries, Ltd., in Moose Jaw and Northern Petroleum in Kamsack, Sask.

Hasty additions to existing plants are expected to bring capacity up to about 65,000 barrels daily before the end of the year. At Lloydminster Ex-

celsior Refineries has bought the Abasand refinery in the northeastern Alberta-McMurray oil sands area and will reerect it as a 3,000-barrel per day plant.

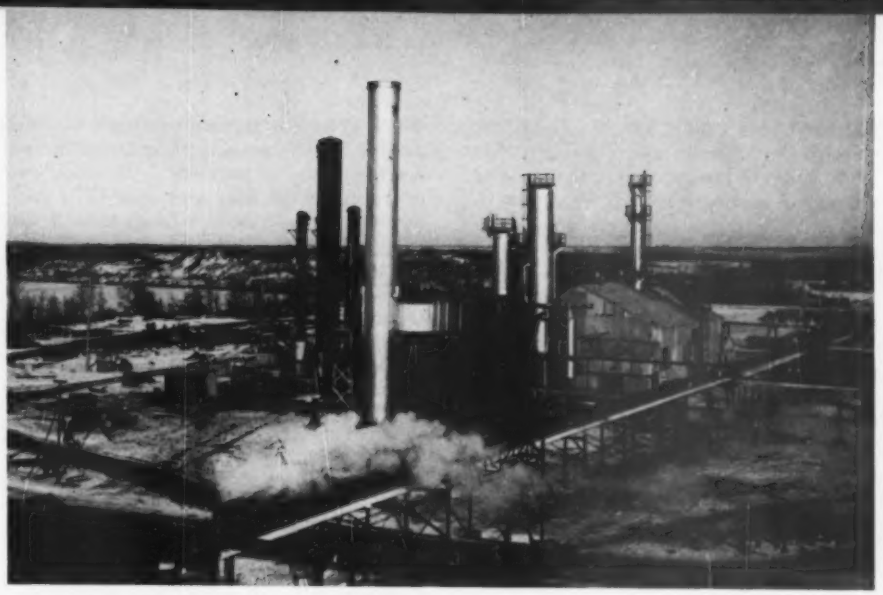
Many reports are in circulation as to new refineries planned for this western area. One of these that appears to be authentically based is the erection of a refinery at Edmonton by McColl-Frontenac Oil Company. J. M. Pritchard, president of the company, has announced a program of $15 million expenditure for production and refining during the coming year. The major part of this will go toward the refinery. A site has been obtained and construction is expected to begin before the end of the year. The company with its affiliate, The Texas Company, is spending millions of dollars yearly on exploration and has more than a million acres under reservation in the northern plains.

Another possible addition to Edmonton's refining capacities is suggested by the report that British American Oil Co., Ltd., has been negotiating for a building site there. No official announcement has been made in reference to this proposed plant, but the company has made it known that it will add to the capacity of its present western refineries.

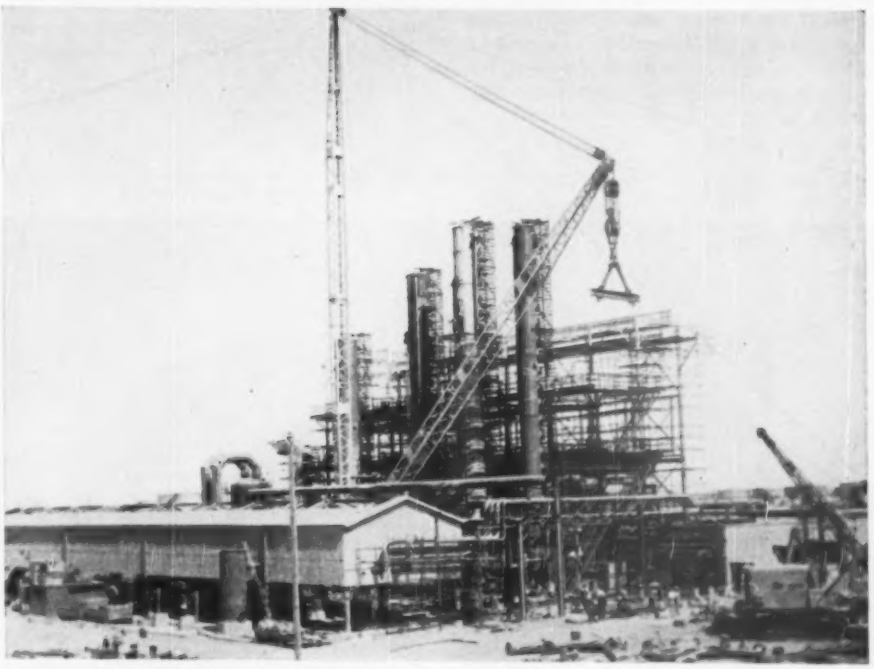
A start toward the opening of broader markets for Alberta oil has been made by Imperial which has announced the organization of Interprovincial Pipe Line Company, with Dr. O. B. Hopkins as president. The company will begin work immediately on a pipeline from Edmonton to Regina. The line is scheduled for completion in 1951. The immediate purpose of the line is to increase the crude oil supply of the Regina refinery, but it is acknowledged that the intention is to extend it later to the Great Lakes where water transportation will be available to move crude or products to points further east. Several applications are pending for permits to build both gas and oil lines to extend to points in Canada and the United States.

In the meantime important refining projects are nearing completion in eastern Canada. At Montreal East the $22 million modernization program of Imperial Oil Ltd. is virtually finished. The crude distillation unit, the light ends unit and the 11,000-barrel catalytic cracking unit went into operation during 1948. The catalytic polymerization plant and offsite additions, including steam generating units, additional storage and a 16-million-gallon water cooling tower, have been finished. The plant's charging capacity has been raised to 37,000 barrels daily.

At Montreal East also the expansion program of British American Oil Company, Ltd., is entering its final stage. Installations include a fluid catalytic cracking unit handling 13,000 barrels per stream day, a catalytic unit polymerizing propylene and butylene for the production of high octane gasoline and new facilities for the production of liquid petroleum gas. Formal opening of the new units will take place within the next few months when the daily capacity of the plant will be raised from 15,000 to 32,000 barrels.



General view of the Imperial Oil Ltd. refinery at Edmonton, Alberta.



Two views of current construction work under way at the 500,000 barrel refinery of Anglo Iranian Oil Co. at Abadan.

Above is the vapor recovery plant erected by E. B. Badger & Sons Co. and Foster Wheeler Corp. Below is the catalytic cracking unit being erected by Foster Wheeler.

Shell Oil Co., of Canada, Ltd., is enlarging the capacity of its Montreal refinery from 10,000 to 27,000 barrels by installation of catalytic grading and vacuum flashing units built by Arthur G. McKee & Co., together with gas recovery and treating units by Fluor Corporation.

South of the Rio Grande Mexico is proceeding with the construction of a 25,000 barrel refinery at Salamanca in the State of Guanajuato. An extensive program of development for the country's oil industry, including the erection of two or possibly three additional refineries, has been drawn up but is awaiting the outcome of negotiations for a large loan from the United States.

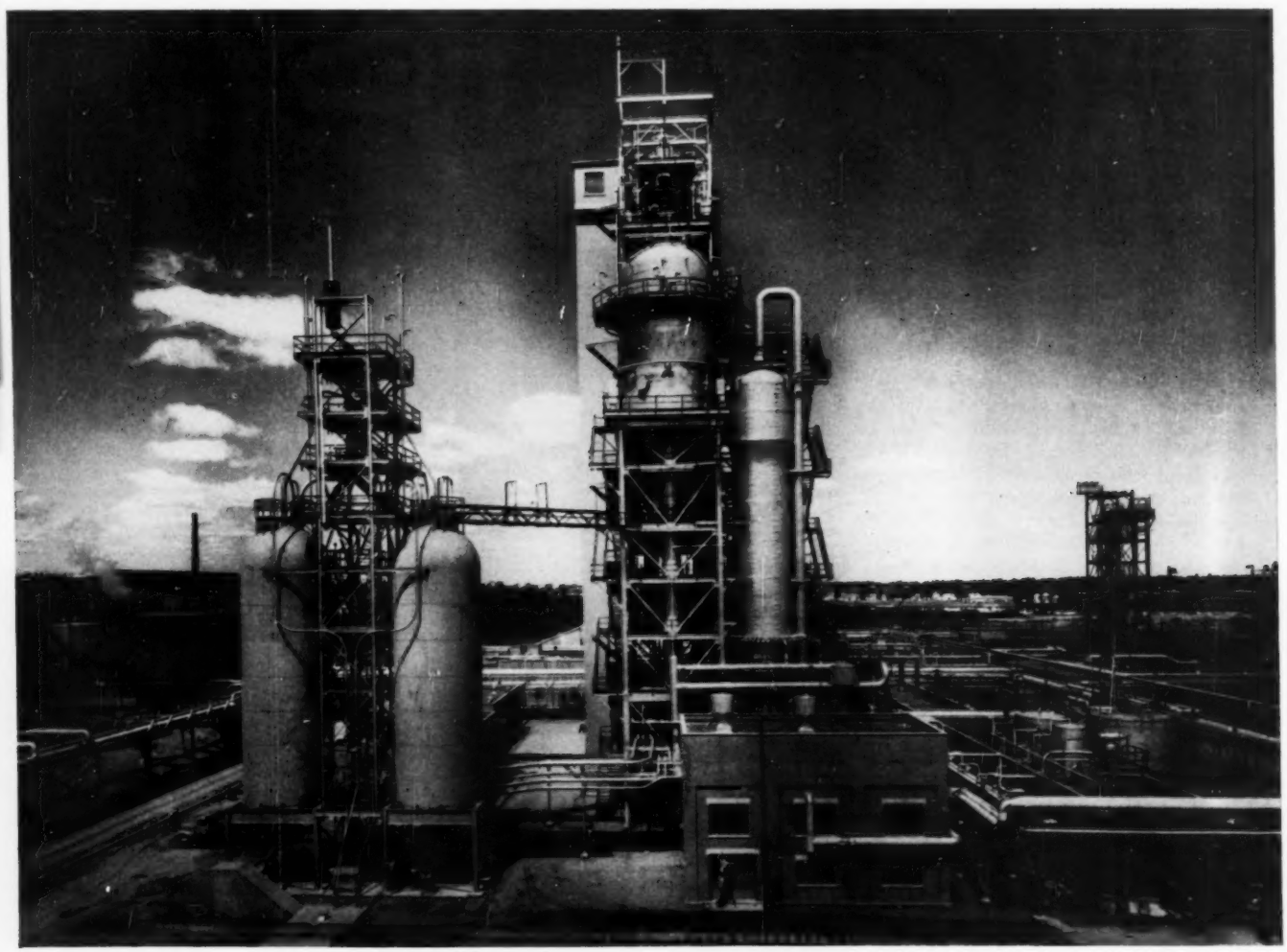
One North American country which expects shortly to establish a refining industry, according to a recent announcement, is the Dominican Republic. Under a contract negotiated between the Dominican government and International Industrial Consultants S.A., a refinery of 25,000 barrels daily is to be erected near Ciudad Trujillo at an estimated cost of $15 million. The refinery will produce a full line of petroleum products but will give special attention to obtaining a high yield of fuel oil for Dominican industries.

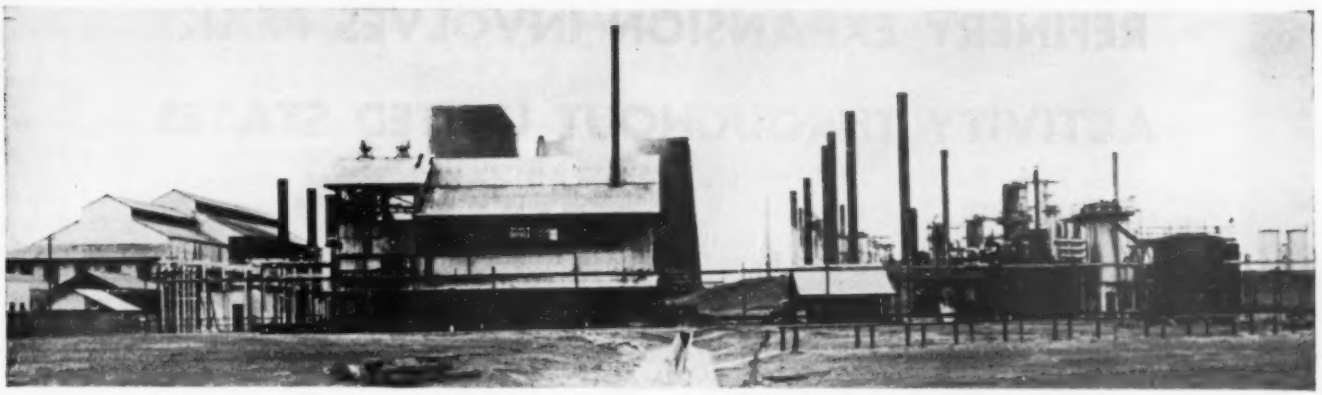
While Venezuela, as much the largest oil producer in South America, is taking the lead in refinery expansion as set forth in an article on other pages of this issue, other countries of that continent are ambitious to build up domestic refining facilities. One of these is Brazil. Its first efforts were directed to finding production, and the first flowing well was brought in at Lobato in the State of Bahia in 1939. In the decade since that discovery five fields have been found, all in Bahia where most of the exploration has been conducted. These fields are Lobato, Candeia, Aratú, Itaparica and D. João.

Candeia at present is the main source of production with Itaparica second, on the island of that name. The most recently discovered field, D. João, is in the initial stage of development, but its oil is of excellent quality and is less than 1000 feet below the surface. National Petroleum Council (CNP), which has charge of all petroleum operations in Brazil, reports that the Bahia deposits are discontinuous and in general restricted, but that the oil is of high paraffin content and rich in lubricants, especially at Candeia.

The 78 wells now producing in Bahia, with reserves of 17.8 million barrels, have a potential yield of 11,600 barrels daily, which is reduced in practice to approximately one-third in order to ensure economic exploitation. To handle this and other production that may result from exploration now under way, the National Petroleum Council at the end of 1948 started work on a refinery at Mataripe. It is a combination topping and cracking unit, the first of its kind in Brazil, and will have an initial capacity of 2,500 barrels. It will produce chiefly gasoline and fuel oil, although it will also be equipped to supply kerosene and diesel oil. Its capacity is to be doubled in the immediate future, and by 1953 is expected to supply 40 percent of Brazil's consumption of lubricants. The undertaking will be administered by a company formed with mixed state and private capital of $2,700,000 U. S., to be known as the Refinaria Nacional de Petroleo S.A. It will aim at supplying the needs of three northeastern states, Bahia, Sergipe and Alagoas. Engineering and construction are being directed by The M. W. Kellogg Company at an estimated cost of $2,000,000 U. S. and will be completed at the end of 1949. Erection of this refinery is expected to effect an annual saving on imports of $2,800,000 U. S. and to produce a revenue from sales exceeding $2,000,000 U. S. yearly.

This 11,000 barrel fluid catalytic cracking unit was the first of its type to go into operation in Canada. It is part of the $22 million modernization program at the Montreal East refinery of Imperial Oil Ltd.





Refinery capacity in Trinidad exceeds current production of the colony's production by about 60 percent and is being further increased by the large additions planned by Trinidad Leaseholds Ltd.

The refining equipment now operating in Brazil consists of three skimming plants for the distillation of imported crude oil without cracking, polymerization or reforming operations. These process about 8,000 tons of petroleum annually, or 3.5 percent of the country's needs. Two are located in Rio Grande do Sul, operated by the Destilaria Rio Grandense de Petroleo S.A. and the Ypiranga S.A. Companhia Brasileira de Petroleo. The third, belonging to Industrias Matarazzo de Energia S.A., is situated in Sao Paulo. They are principally engaged in supplying products for local consumption.

In October last the government took a definite step toward the installation of plant to process imported petroleum in sufficient quantities to meet domestic requirements, which are now estimated at 40,000 barrels daily and will probably be doubled during the next five years. Toward the end of 1946 two financial groups, led by Alberto Soares de Sampaio and Drault Ernanny de Milo e Silva, obtained from CNP authorization to install refineries, the former at Sao Paulo and the latter at Rio de Janeiro. Two companies were then formed, each with an initial capital of $3,200,000 U. S., the Refinaria de Petroleo do Distrito Federal S.A. by the Drault Ernanny group, and the Refinaria e Exploracão de Petroleo União S.A. by Soares Sampaio. Neither, however, was able to obtain the necessary equipment owing to the lack of exchange facilities. In order to avoid further delay, it was arranged that the Sampaio group should acquire in Czechoslovakia a thermal cracking unit with capacity for 20,000 barrels daily, payment to be made against Brazil's accumulated funds in that country, amounting to $13,000,000 U. S., to be refunded in Brazil in cruzeiros. At the same time the Ernanny group, which was already in negotiation with an American firm, received an advance of between eight and ten million dollars for the construction and installation of similar plant to process 10,000 barrels daily at Rio de Janeiro. By the terms of their contracts, both companies must pay the government an appreciable percentage of their profits, to be employed in prospecting and drilling.

A third thermal cracking unit with capacity for 45,000 barrels daily is to be purchased and operated by the Federal Union at Belem, Para. It will be acquired in France and paid for out of Brazil's frozen funds there. Part of the special equipment will be obtained by the French companies in the United States, where the plans will be drawn up. North American experts will also supervise the construction and installation work. The above three refineries will process only imported crude oil for the present.

Architect's drawing of office building at the Pernis' Holland refinery being erected by Caltex Petroleum Maatschappij.

Tankers with a total carrying capacity of 180,000 tons will also be acquired and administered by the government. Six of these will be built in national yards, the remainder being purchased in Spain, Holland and Belgium.

Brazil now imports 2,600,000 tons of petroleum products annually from the United States and Venezuela at a cost of $75,000,000 U. S., representing seven percent of her total foreign purchases. The installation of refineries and use of national ships should result in an economy of $34,000,000 U. S. in foreign exchange, which will be available for imports of much-needed equipment and machinery for agriculture and industry. The total sum to be allotted to development of the petroleum industry under Brazil's Salte Plan, now awaiting Congress approval, amounts to $135,000,000 U. S., to be spread over five years.

Further measures to accelerate development are held up pending approval of a new petroleum statute to replace the 1938 law. The latter, which was drawn up in accordance with the Vargas Constitution of 1937, nationalized the refining of crude oil, whether produced in the country or imported, and excluded foreign participation from all branches of the industry. The proposed new statute, which follows the more liberal Constitution of 1946, elaborated after the fall of the dictator, has been before Congress since February 1948. It will allow foreign companies to refine and transport petroleum for exportation, once the needs of home consumption are satisfied. This is one of the points on which the Nationalists seize, charging that it will permit the entry of refining and transport companies formed entirely with foreign capital, which will have full liberty to export their products and market them in the country. Continued opposition by a vociferous

(Please turn to page 104)

REFINERY EXPANSION INVOLVES PEAK ACTIVITY THROUGHOUT UNITED STATES

THE year 1949 is one of rapid progress in refinery construction in the United States. It is carrying forward programs of expansion formulated last year and the year before which were slowed by delays in deliveries of materials and equipment and is marked by the initiation of many new projects for the expansion and improvement of existing plants. Activity is well distributed throughout the country, with especially noteworthy additions to capacity at Atlantic and Gulf Coast points and in the Rocky Mountain region, the latter in recognition of the growing importance of that area in the supply of petroleum and its products.

General trends are observable in the numerous installations of large distillation and catalytic cracking units, the increasing flexibility of plants, enabling them to adjust their operations to changes in consumer demand for products, and simplification in design based on recent experience, resulting in greater efficiency and economy. While big plants have been growing larger, many smaller refineries have been taking advantage of the adaptation of catalytic processes to their requirements as a means of bettering their local competitive position.

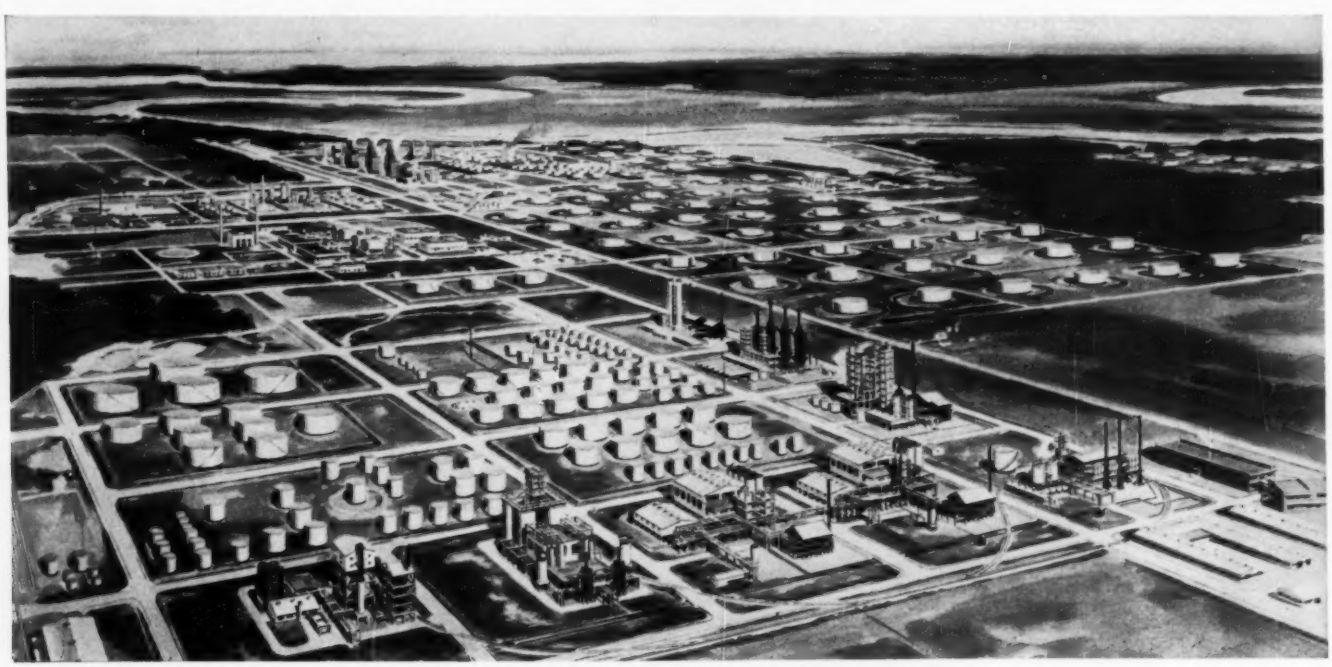
On the Atlantic Coast a notable event of the year will be the opening of the first section of the first entirely new refinery to be built in that region in several years. This is the large plant which The Texas Company is erecting at Eagle Point on the New Jersey side of the Delaware River near Philadelphia. The plant occupies a site of approximately two square miles which allows ample room for planned future expansion. It has a frontage of over two miles on the river, and three large docks will permit direct deliveries from ocean-going tankers. Work on the power plant and processing structures is proceeding rapidly, and the refinery is scheduled to go on stream during the second half of the year.

Initial operation will be on the basis of 40,000 barrels of crude charging capacity per day. The plant is designed primarily for the production of gasoline, No. 2 heating oil, diesel oil and industrial fuel oil. Its principal features are its large distillation units, a fluid catalytic cracker, a furfural plant and catalytic polymerization unit. It will be equipped to handle sour crudes if necessary. The plant will be wholly self-contained with its own power plant supplying all electrical requirements, a water supply from wells on the property and storage capacity for over a million barrels. The crude distillation units are being built by Foster Wheeler Corp., the catalytic cracking and polymerization units by The M. W. Kellogg Co., and the furfural plant by Graver Construction Co.

Sinclair Refining Company's extensive modernization program at its Marcus Hook, Pennsylvania, refinery, including installation of vacuum stills, catalytic refining and a polymerization unit and other expanded utilities, was completed in 1948 and has been in full operation since, charging up to 25,000 barrels daily of gas oil. The gas recovery unit processes fluid gases, recovering all of the butane and most of the propane.

Sun Oil Company has added a furfural solvent extraction plant and a wax plant to its Marcus Hook refinery during the past year and has enlarged its Mercury vapor lubricating capacity. At nearby Paulsboro, New Jersey, Socony-Vacuum Oil Company has made a number of new installations including crude distillation, furfural, solvent dewaxing, deasphalting and light ends treating units as part of its $35 million improvement program. The units, designed by

A general view by artist John A. Kenny of Cit-Con Corporation's new lube plant at Lake Charles, La. The Cit-Con plant is in the foreground, with its eight manufacturing units in the shape of an L built around the storage facilities, and with administration buildings shown in the right foreground. Directly above the Cit-Con plant, and at the left of the picture, are the Firestone synthetic rubber plant and the government-owned, Cities Service-operated butadiene plant. The entire area in the center of the drawing is occupied by the Cities Service Tutwiler refinery, with the Calcasieu River in the background. Drawing Courtesy Cities Service Oil Co.



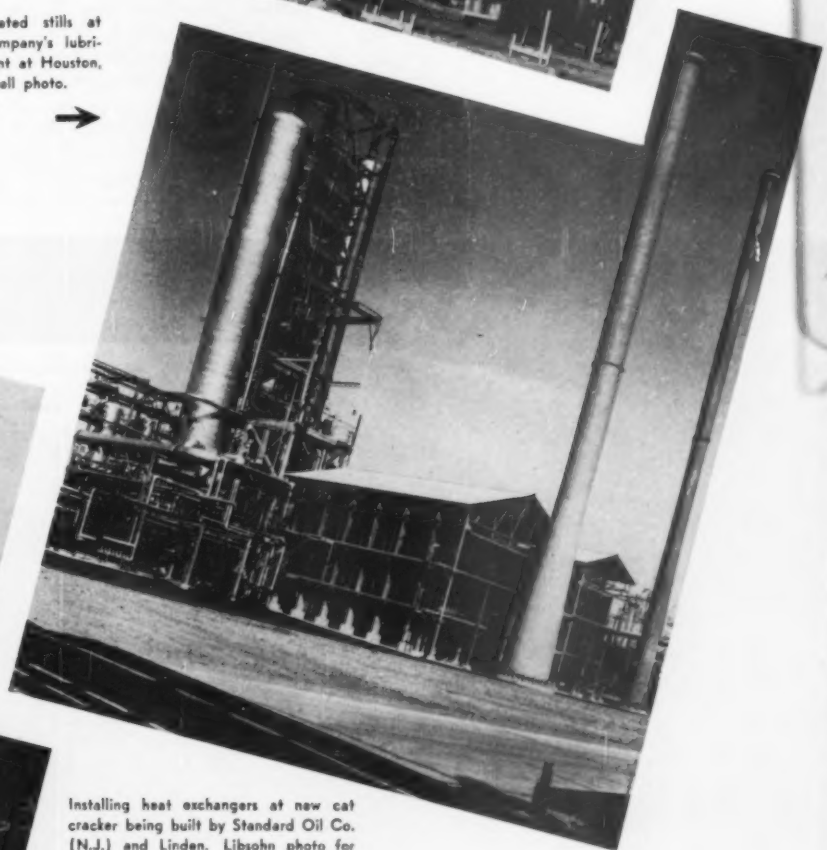
E. B. Badger & Sons Co., are nearing completion and are expected to go into operation before the end of the year, giving the plant a processing capacity of 60,000 barrels per day.

In the New York area Esso Standard Oil Company, has continued the expansion of its great Bayway refinery at Linden, New Jersey, by numerous additions, the most notable of which are a vacuum still with a capacity of 49,000 barrels per day and a fluid catalytic cracker with a charge capacity of 41,000 barrels per stream day. These are among the largest, if not actually the largest, single units ever installed in a refinery, and their great size has been attained with a simplification of design that has attracted much interest among technical operating men.

The cracking installation is equipped with a reactor 35 feet in diameter in which preheated gas oil, which constitutes the feed, is vaporized by contact with a catalyst in a turbulent state. The cracked vapors flow through cyclone collectors where entrained particles of catalyst are trapped and recovered and then pass to a fractionator 135 feet in height, from which the product streams of gas, distillates and heavy gas oil are removed. Spent catalyst from the reactor is conveyed through a transfer line to the regenerator, 55 feet in diameter, where the accumulated carbon is burned off with oxygen. The size of the operation is indicated by the fact that the quantity of catalyst handled reaches 75,000 tons per day. Water requirements for the plant are 120 million gallons per day.

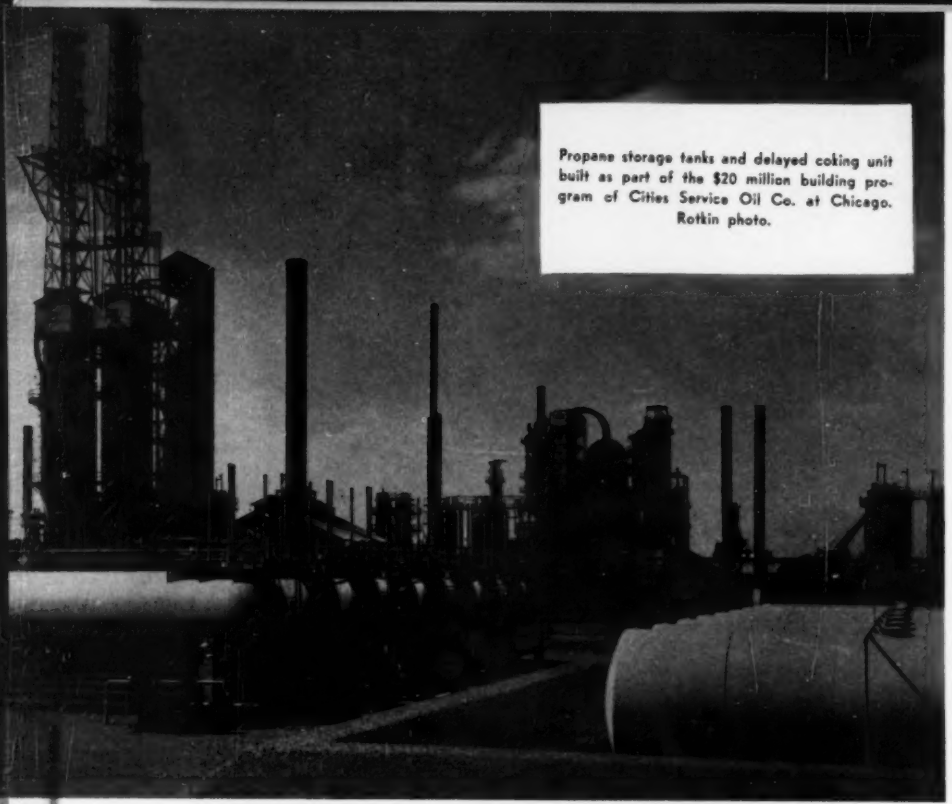
The light ends unit of the plant is designed to handle 33 million cubic feet of gas per day. Gas is conveyed to the unit by two multistage centrifugal compressors driven by 33,000-hp steam turbines and is separated into various cuts for further processing to gasoline, polymers and fuel oils. The plant is being constructed by C. F.

Installing regenerator head on the cat cracker of The Texas Company's new Eagle Point, N. J., refinery. Stevens photo.



Newly completed stills at Shell Oil Company's lubricating oil plant at Houston, Texas. Shell photo.

Installing heat exchangers at new cat cracker being built by Standard Oil Co. (N.J.) and Linden. Libsohn photo for Esso.



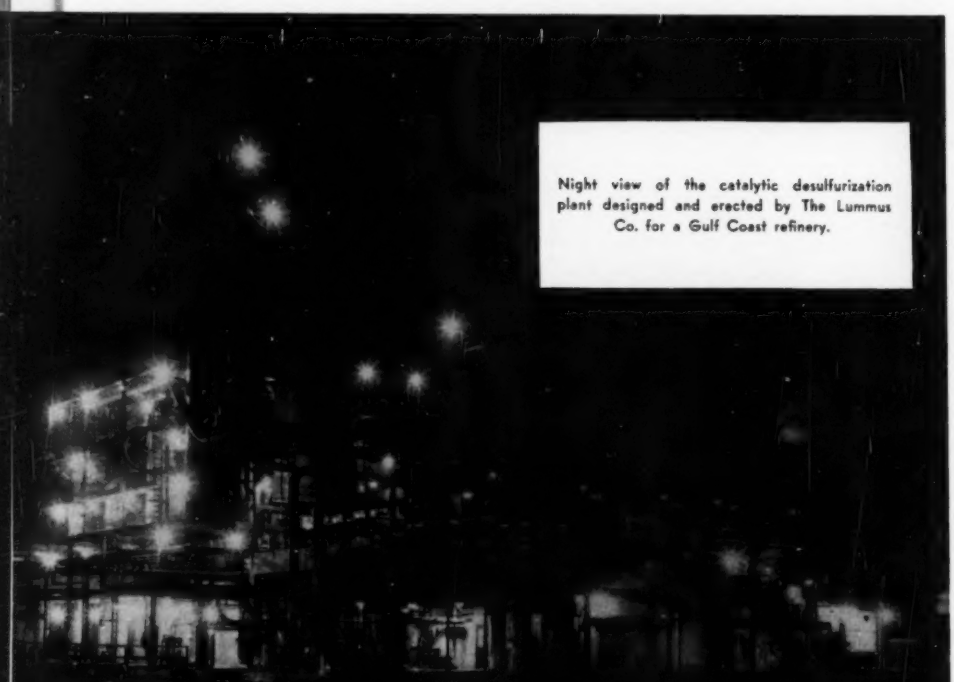
Propane storage tanks and delayed coking unit built as part of the $20 million building program of Cities Service Oil Co. at Chicago. Rottin photo.

Braun & Co., refinery engineers. It is expected to go on stream within the next two months.

At the Bayonne, New Jersey, plant of Esso Standard, an MEK solvent dewaxing plant is under way to increase the production of lubricating oils and wax. It will have a charging capacity of 7,500 barrels daily and is scheduled for completion in 1950.

In the Central States where there has been a rapid growth in demand for petroleum products since the close of the war, a number of important construction undertakings are under way, some of them nearing completion and others scheduled to be finished in 1950 or 1951. One of these to which special interest attaches is the $18 million expansion program of Sun Oil Company at its Toledo, Ohio, refinery. It is featured by an installation described by the company as an improved catalytic cracking process.

The new unit is designed to charge 42,000 barrels a day to the reactors with a high proportion of heavy feed. The plant is being built by Catalytic Construction Company of Philadelphia, and the process to be employed, known as Houdriflow, has been developed jointly by Houdry Process Corporation and Sun Oil Company. An unusual feature of the design is that all of the catalytic elements, such as the reactor and kiln, are of a new so-called "packaged" type. They are of such size that they can be fully assembled in the shop and shipped to the site by rail, with consequent saving in erection time and cost.



Night view of the catalytic desulfurization plant designed and erected by The Lummus Co. for a Gulf Coast refinery.

Also scheduled for construction at the Toledo refinery are a large gas recovery and gasoline stabilization plant, a new polymerization plant, a crude distillation unit, a vacuum flash unit and auxiliary units and equipment required by the major installations. These include a steam generating unit, a water supply and cooling unit, charge and product tankage, storage facilities, a warehouse, maintenance shops, an electric substation and offices for operating personnel.

All new units will be integrated with existing installations to increase the overall efficiency of the refinery. When completed, they will almost double the capacity of the Toledo refinery and place it among the 20 largest in the nation.

Catalytic Construction Company, a subsidiary of the Houdry Process Corporation, is handling purchasing, expediting and field construction. Process design for the gas compression unit was done by Fluor Corporation. Process Engineers, Inc., designed the gas absorption and gasoline stabilization unit. Major construction is expected to be completed by January, 1950.

In pursuance of the program of modernization which Pure Oil Company has been carrying out at its refineries to provide greater flexibility of operation, a delayed coking unit was added to the company's Toledo plant during 1948. The feed to the coking unit is a reduced crude charge from the combination high pressure distillation units. The coking plant is equipped with two vertical drums so that one can continue in operation while the other is being cleared. Other facilities being installed at the refinery will make possible the production of a full line of aromatic naphthas. At the Heath, Ohio, refinery Pure Oil completed installation of a fluid catalytic cracking unit designed by M. W. Kellogg Company for the purpose of increasing the plant's supply of high octane base stock.

Another addition to refining capacity in Toledo is the installation by Gulf Refining Company of a crude distillation unit and a fluid catalytic cracking plant in its refinery in that city as part of the complete modernization of the plant. The improvements made at Toledo are being practically duplicated in the company's Cincinnati, Ohio, plant, both of which are to be completed during the current year. Construction is in the hands of E. B. Badger & Sons Co. and the M. W. Kellogg Co.

Standard Oil Co. (Ohio) has under way a $29 million program of expansion at its Lima, Ohio, refinery. The program is in three parts. First of these is a fluid catalytic cracking unit that is

now under construction and represents an investment of $11 million. The second, authorized last year, is a combination crude and coking unit which is being built by M. W. Kellogg Co. at a cost of $5 million to produce feed stock for high test gasoline as well as furnace oils and petroleum coke for industrial use. Late in 1948 it was announced that contracts had been let involving the expenditure of $13 million for a lubricating oil plant, thus raising to $29 million the investment at this one refinery in the company's three-year, $100 million development plan.

The new lube plant is just emerging from the planning stage. Its five units will provide vacuum distillation, solvent deasphalting, solvent extraction, solvent dewaxing and clay treating. Four of the units will be constructed by The Lummus Company. The deasphalting unit will be engineered by M. W. Kellogg Co. When completed, the plant will produce 76,000 gallons daily of finished solvent refined lubricating oils, more than doubling the company's output in this department. When all the improvements planned by Sohio are in operation, the charging capacity at its several refineries for the first time will be raised to more than 100,000 barrels daily.

Socony-Vacuum Oil Company will install in its Trenton, Michigan, refinery one of the four thermal catalytic cracking (TCC) units which it will place in its refineries. These are announced by the company as being of improved design, effecting a substantial reduction in initial investment and operating cost and increasing the flexibility of the TCC unit. Completion is expected by the end of 1950.

At Robinson, Illinois, extensive additions to the refinery of Ohio Oil Company have been completed, raising its crude charging capacity to 25,000 barrels daily and its cracking capacity to 12 400. New installations include a catalytic cracking unit, a catalytic polymerization unit, a gas recovery plant and a gasoline treating plant, all engineered by Arthur G. McKee & Co.

At Lawrenceville, Illinois, The Texas Company has projected additions to its refinery which will bring its daily capacity up to 30,000 barrels. They will include a fluid catalytic cracker and catalytic polymerization unit, a crude desalting unit and vacuum units designed to handle sour crudes. The work is expected to reach completion in 1950.

Cities Service Company early this year completed the reconstruction and enlargement of its refinery at East Chicago, Indiana, at a cost of approximately $20 million. Principal additions are a delayed coking unit which processes 17,500 barrels per day of topped crude and a fluid catalytic cracker charging 14,760 barrels per stream day and recycling 6,860 barrels of gas oil to produce gasoline, a propane-butane mixture, gas oil and fuel gas. Other features are a gas recovery system, a light ends unit, gas purification unit, power plant and water treating system. Daily capacity of the plant is 35,000 barrels.

At East Chicago also Sinclair Refining Company has completed its enlargement program which included a fluid catalytic cracker of 25,000 barrels daily charging capacity and a lubricating oil plant, including propane deasphalting, phenol treatment and MEK dewaxing, and the plant is now in full operation.

In its midwestern division Socony-Vacuum's additions are centered around the refinery at East St. Louis, Illinois. They comprise new crude distillation, thermal three-coil cracking, delayed coking and light oil treating facilities. Together with these process units are increases to various utilities. Final completion of this work is scheduled for the last quarter of 1949 and will bring the capacity of this refinery to 30,000 barrels of crude daily. The work at East St. Louis includes the addition of a new river barge loading terminal.

At Wood River, Illinois, plant of Shell Oil Co., a 5,000 KW turbine generator was added to the three previously installed to increase the electric power generating capacity from 15,000 to 20,000 KW. A 175,000-pound per hour boiler has been installed to supply steam at 650 pounds pressure and 750°F to the generator and refinery process units. A modern tank farm is being constructed at Wood River to provide crude storage for the refineries entire needs.

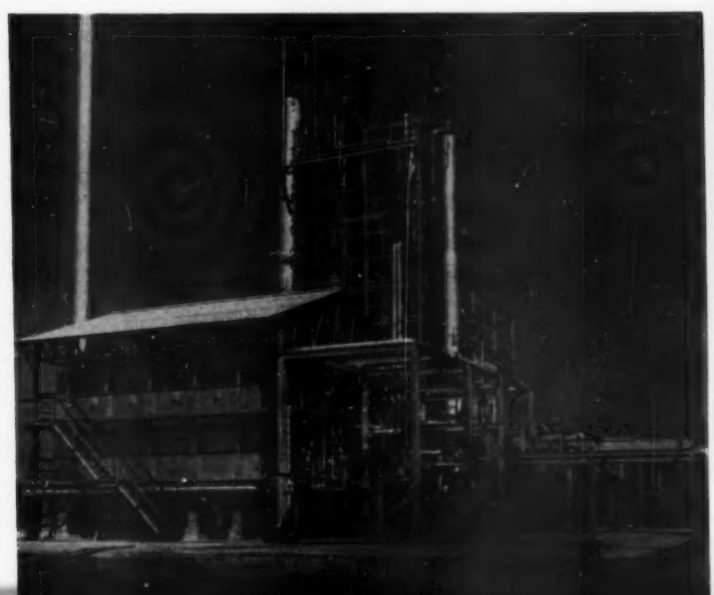
Through a general program of modernization and enlargement the eight refineries of the Phillips Petroleum Company in various locations from Texas to Montana have raised their charging capacity to 167,000 barrels per day. Latest addition to the company's facilities is the lubricating plant at Kansas City, Kansas, which has just been completed. It includes equipment for vacuum distillation, deasphalting, propane fractionation, phenol extraction, propane dewaxing and clay treating. A feature of the plant is the elaborate installation for the blending and packaging of the complete line of aviation, automotive and industrial oils which is operated by a subsidiary, Phillips Oil Company. The plant's operations are mainly performed by automatic machinery which insures complete uniformity and freedom of the product from contamination.

Cooperative Refinery Association at Coffeyville, Kansas, has continued its plan of expansion which has included installation of catalytic cracking and polymerization units, a vacuum distillation unit and a furfural extraction plant completed last year. Latest addition is an MEK solvent dewaxing plant constructed at a cost of two million dollars. This plant is nearing completion and is expected to be ready for operation within the next month or two. A new cooling tower, steam generator and storage tanks are being installed.

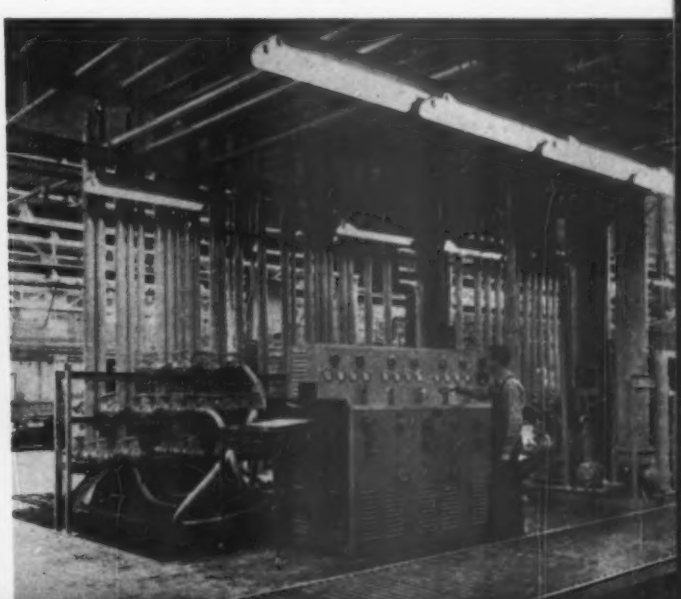
At Augusta, Kansas, Socony-Vacuum Oil Company is preparing to construct a new type TCC unit, which with other additions will raise the daily charge capacity to 25,000 barrels by the end of 1950, and at El Dorado, Arkansas, Lion Oil Co. is enlarging its chemical plant to

Please turn to page 96

Furfural solvent refining unit recently completed at Beaumont, Texas, by Magnolia Petroleum Co. Photo courtesy The Lummus Co.



Control panel for blending lubes at the Kansas City compounding plant recently completed by Phillips Oil Co., subsidiary of Phillips Petroleum Co.



THE CONTINUOUS CONTACT COKING PROCESS

By A. H. Schutte* and W. C. Offutt**

IN general, during the past ten to twenty years, refineries have coked their heavy residual stocks to produce more valuable light oils when minimum fuel oil and maximum gasoline were desired. These coking operations were carried out in fired batch coke stills or with tubular oil heaters discharging into coking drums which were operated on a non-continuous or time-cycle basis. These processes have high labor requirements and require expensive coke-removal equipment.

During the war and shortly after residual fuels were in demand, thereby reducing the desirability of coking in the plant and deferring the stimulus for the development of new processes which would not have the disadvantages of shell stills or delayed coking. However, this situation has changed recently, owing to the requirement of maximum distillate oils for catalytic cracking charge and the shortage of light distillate oil required to cut the virgin residuum to fuel oil viscosity specifications. In addition, there is a reduced market for the final blended residual fuels and the sales price has dropped considerably. The conversion to coke and light oils of the heavy residual bottoms fraction of the crude, after all gasoline, kerosene, furnace oil, and catalytic charging stock have been removed, results in additional catalytic charging stock, more gasoline, and releases to light heating oils the catalytic cutter oils otherwise used to blend off the flux tar bottoms to fuel specifications. Since the demand has increased for light oils to be used as heating and diesel fuels, any process which reduces the supply of residual fuel and increases the supply of light oils is attractive from an economic standpoint. A new continuous and simplified coking process has been developed for the conversion of these heavy-residuum oils and tars into coke and valuable light hydrocarbon products.

A simplified flow diagram of the recently developed Continuous Contact Coking Process is shown in Figure 1. The heavy hydrocarbon residuum charge is preheated at a temperature of 750-850°F in a conventional tubular preheater. Even the heaviest residual stocks have a viscosity of less than that of water at these temperatures. The preheated oil charge is then contacted on a relatively large quantity of hot circulating coke which has been produced in the process and is in the form of rounded lumps of ¼" to ¾" size. The temperature of the wetted coke after application of charge oil may be varied from 850 to over 1000°F by changing the preheat or the circulation rate of the coke. The preheated residual hydrocarbon oils are distributed uniformly on the circulation coke. Since the oil is practically non-viscous at these elevated temperatures, it distributes itself and is taken up by the coke particles as a thin liquid microfilm with no adhesion or agglomeration of the circulating solids occurring. No trouble arises from plugging or flow stoppage during the time the high-temperature, non-viscous residual oil is being coked to a solid. The coking reaction of the oil on the coke is carried on gradually in a cylindrical reactor vessel through which the wetted coke flows uniformly by gravity as a bed of free particles. The reactor volume is sufficient to give a solids residence time of 15 to 40 minutes, which is more than adequate to complete the conversion of liquid to produce vapors and dry coke.

The coke stream from the bottom of the reactor, carrying the increment coating produced from the forementioned coking step, passes through a sealing zone into a reheater where it is heated by radiation and convection to the proper temperature for recirculation to the oil feed contact point. The circulation of the reheated coke may be carried out by conventional mechanical elevators, such as have been used successfully in catalytic cracking plants, or by means of a vapor lift system.

* The Lummus Company, New York, N. Y.
** Gulf Research & Development Co., Pittsburgh, Pa.

Fig. 5—Plan and elevation.

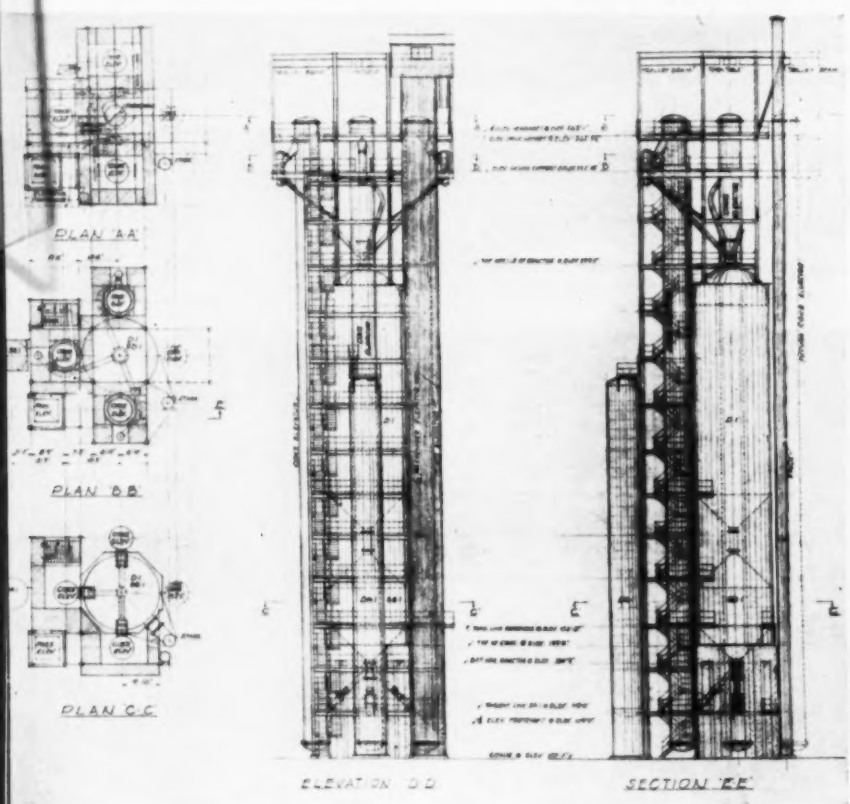
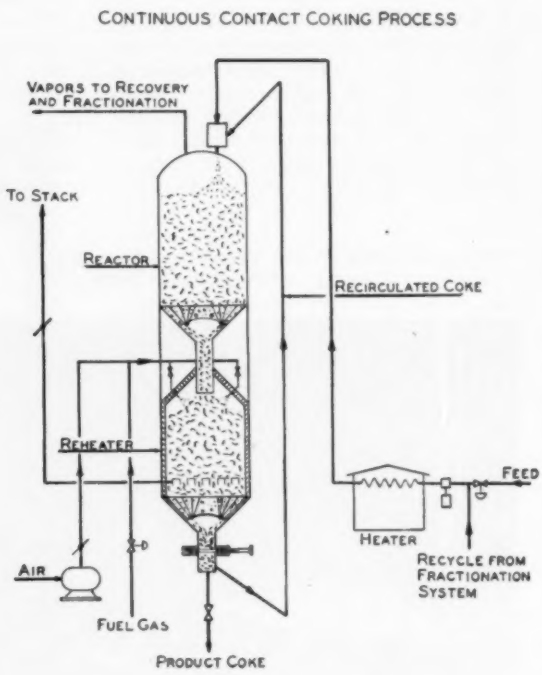


Fig. 1—Simplified flow diagram.



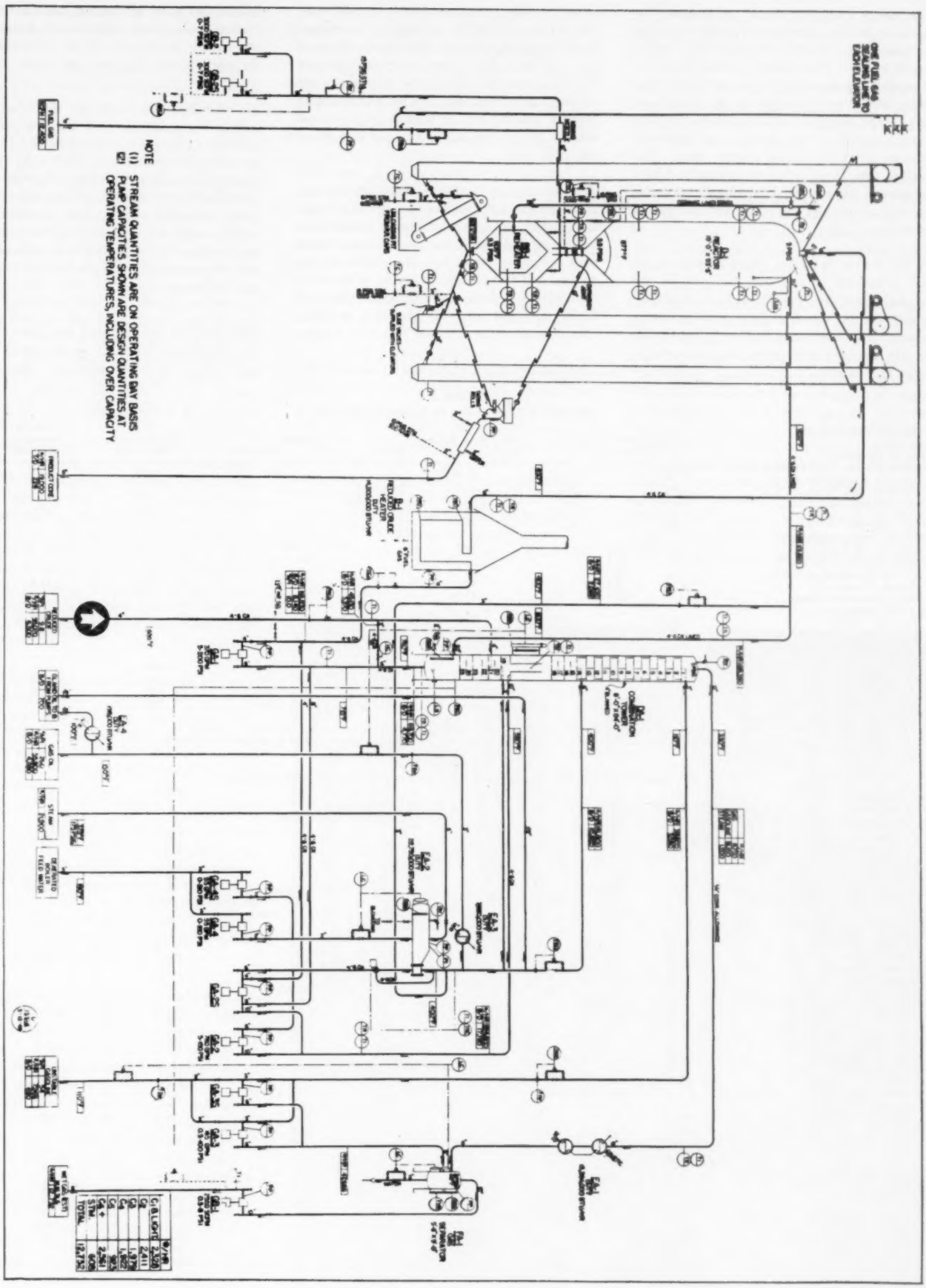

NOTE
(1) STREAM QUANTITIES ARE ON OPERATING DAY BASIS
PUMP CAPACITIES SHOWN ARE DESIGN QUANTITIES AT
OPERATING TEMPERATURES, INCLUDING OVER CAPACITY

Fig. 4. Process flow diagram, commercial contact coking unit.

The vapors from the reactor are normally removed at the top, adjacent to the coke inlet, and are quenched in the usual manner with a heavier recycle stream. The oil vapor contains a mixture of cracked components which are produced from coking the heavier fractions of the charge and heavy virgin oil vapors which have been distilled under conditions of low pressure and high temperature at the oil charge contact zone. The products from this method of coking have been subjected to a minimum of cracking and degradation and are suitable for subsequent catalytic or thermal cracking.

As the coking operation proceeds, and successive increments of coke are deposited on the circulating particles, there is an increase of coke inventory in the system and a general increase in particle size. The net production is then drawn off as a free-running stream of dry lump coke of about ¼" diameter.

Since the coke is deposited in the form of many thin layers (1/1000"), and since it is reheated after each passage through the reactor, the product coke has a very dense structure instead of the foamy texture which is characteristic of the ordinary petroleum coke. The higher coking temperatures and lack of large pores give a low volatile content and high mechanical strength to the coke.

The Continuous Contact Coking Process produces less gas, less gasoline, more gas oil of superior quality, and less coke than do conventional coking methods operating on the same charge stock. Heavier stocks such as asphalts, pitches, and reduced tars may be processed, whereas the conventional methods, such as delayed coking, are limited to lighter materials which can be heated to a temperature of 900-930°F in fired heaters.

The investment cost of continuous contact coker is about 60 to 80 per cent of that for the most modern conventional methods, and a significant cost saving is obtained by the elimination of the coke-removal equipment and crew.

The development work on the Continuous Coking Process began more than five years ago with the construction of an isothermal fixed-bed laboratory bench-scale unit. This unit was constructed to establish the range of process conditions required for the coking without binding together the solids with the coke product and to evaluate such basic variables as oil to solids ratio, solids residence time, and solids temperatures and their effect on yields of light hydrocarbon products and coke.

Operations on the fixed-bed unit demonstrated that the injected heavy oils would wet all of the particles approximately equal and that coking

TABLE I

Pilot Plant Contact Coking of Various Reduced Crudes

Reduced Crude Charge	42% West Texas		15% West Texas	Illinois		Santa Maria	Eastern Venezuela
Pilot Plant	Laboratory		Semi-Commercial	Semi-Commercial	Laboratory	Laboratory	Laboratory
Type of Operation					Single-Pass		
Product Yields, % of reduced crude charge							
Gas (C_3 & Lighter), wt. %	3.1	4.0	13.0[1]	8.1[1]	2.9	7.1	5.3
Gasoline, vol. %	4.8	4.9	15.7	12.1	13.7	8.0	7.6
Gas Oil, vol. %	83.1	84.8	70.9	80.3	83.8	65.0	81.6
Coke, wt. %	6.8	6.5	5.1	3.1	8.1	15.4	13.6
Loss, wt. %	2.7	0.0	1.1	0.4		1.2	0.0
Reduced Crude Inspection							
Gravity, °A.P.I.	18.2		10.7	18.4		5.8	13.4
Viscosity, S.U.S. at 210°F.	97.4			169			
Vol. % Overhead at 900°F.	53		15	33		21	25
Carbon Residue, %	6.4		11.5	8.0		14.2	13.8
Characterization Factor	11.7		11.25	11.8		11.4	
Gas Oil Inspections							
Gravity, °A.P.I.	23.2	23.5	17.5[2]	22.9[2]	25.8	17.0	20.9
Viscosity, S.U.S. at 210°F.	41.7	40.6		48.0			56.2
Characterization Factor	11.6	11.6	11.31	11.8	11.75	11.2	
Vacuum Distillation, °F. at 760 mm.							
10% 550	528		600	634	530	405	606
50% 752	745		807	841	760	755	815
90% 977	977		939	974	935	955	984
Endpoint 1003	1003				1000	965	

[1] Yields from the semi-commercial pilot plant are not representative of optimum operating conditions due to limited reactor volume.
[2] Inspections are of rerun gas oils with yields of 43.4 and 57.5 vol. % of charge from West Texas and Illinois reduced crudes, respectively.

TABLE II

Once-Through Contact Coking of 30 Per Cent Eastern Venezuela Reduced Crude

Run Number	53	54	55A	55B
Solid Medium	7 A.I. Clay		Coke	
Operating Conditions				
Oil Inlet Temperature, °F.	851	852	848	847
Oil Vapor Outlet Temperature, °F.	898	873	862	832
Solids Inlet Temperature, °F.	953	955	902	857
Average Reactor Temperature, °F.	845	838	855	840
Reactor Pressure, lbs./sq. in. gage	7.0	5.1	5.0	5.0
Solids Residence Time, minutes	30	29	20	20
Yields, vol. % of charge				
Debutanized Gasoline	9.1	9.4	5.3	5.9
Butane-Butene	1.6	1.6	2.3	2.3
Propane-Propylene	1.9	1.9	2.9	2.8
Furnace Oil	6.8	6.3	5.9	3.5
Heavy Gas Oil	71.0	72.5	75.7	72.3
Gas (C_3 & Lighter), wt. %	1.7	1.6	2.4	2.5
Coke, wt. %	15.6	14.7	13.6	18.8
Charge Stock				
Gravity, °A.P.I.	13.2	Same	Same	Same
Carbon Residue, %	10.9	as	as	as
Sulfur, %	1.67	Run	Run	Run
Vacuum Distillation, °F. at 760 mm.		53	53	53
Overpoint	502			
10%	760			
20%	825			
30%	878			
40%	950			
Properties of Rerun Products				
Gasoline				
Gravity, °A.P.I.	51.0	49.6	53.3	54.9
Reid Vapor Pressure, lbs./sq.in.	1.4	1.0	1.0	3.0
Oxygen Stability, minutes	456	14		
Preformed Gum, mg./100 cc.	18	168	57	
Bromine Number	91	75	84	
Aniline Point, °F.	93	94	128	128
Sulfur, %	0.6	1.4	0.6	0.6

Run Number	53	54	55A	55B
Solid Medium	7 A.I. Clay		Coke	
A.S.T.M. Distillation, °F.				
I.B.P.	176	164	160	143
10%	228	218	219	201
50%	300	300	299	280
90%	375	374	360	365
E.P.	409	403	398	392
Motor Octane Number, clear	67.6	63.9	60.2	60.4
" " " +3 cc. T.E.L.	74.1			
Research Octane Number, clear		71.2		
Run Number	**53**	**54**	**55A**	**55B**
Furnace Oil				
Gravity, °A.P.I.	32.9	32.4	33.4	35.3
Aniline Point, °F.	113	120	128	131
Sulfur, %	1.2	1.3	1.3	1.2
A.S.T.M. Distillation, °F.				
I.B.P.	416	440	448	428
10%	445	465	470	450
50%	483	506	501	482
90%	559	580	569	554
E.P.	609	620	629	602
Total Gas Oil				
Gravity, °A.P.I.	21.8	21.8	20.9	22.2
Aniline Point, °F.	170	178	173	175
Acid Heat, °F. (A.S.T.M.)	35	41	21	30
Bromine Number	19	21	13	17
Pour Point, °F.	95	95	105	105
Sulfur, %	1.3	1.3	1.2	1.4
Carbon Residue, %	0.9	1.3[1]	1.9	0.9
Viscosity, S.U.S. at 130°F.	95.5	142	189	146
" S.U.S. at 210°F.		50.5	65.2	51.0
Vacuum Distillation, °F. at 760 mm.				
I.B.P.	399	440	391	409
10%	537	578	606	572
50%	763	828	815	805
70%	815	872	886	862
90%	885	934	984	942

[1] 90% overhead on Run 54 total gas oil was 22.8°A.P.I., 0.03 carbon residue. See Table III.

could be accomplished even in a static bed without cementing of the inert solids.

Charge stocks ranging from 4.8°API, 117°F melting point Santa Maria bottoms to a light 18°API East Texas fuel oil were coked to obtain data for the design of a large-scale continuous laboratory pilot plant. Figure 2 is a photograph of the control section of a two-gallon per hour continuous pilot unit which was constructed in the spring of 1944 and successfully operated on a variety of charge stocks and inert solids, including beach gravel, coke, and spent T.C.C. catalyst. The operations using solids other than coke were made by continuously burning the deposited carbon from the circulating solids. In the coking-on-coke runs the reheating of the circulating coke was done by continuous partial combustion. Only the necessary quantity of coke was burned to reheat the circulating coke mass to the desired contact temperature. Coking-on-coke runs were also made by continuous non-oxidizing reheating using radiation and convection. Most of the latter runs were made for coke production, since the fuel balance in most refineries is such that an operation for coking-on-coke with the production of coke as a product looked more generally attractive than an operation using inert refractory solids with generation of steam from the heat of combustion of the residual coke. Extended runs were also made to determine the characteristics of the equilibrium coke after 65 passes through the coking reactor. The early pilot unit data were checked and extended by independent pilot plant work in the Gulf laboratories.

The combined laboratory-scale pilot plant work described above had defined the solids to oil ratios, solids residence time, temperature, and yield distribution characteristics of the contact coking process. It had also shown the feasibility of using coke as a circulating material and producing coke continuously as a product.

Since most of the current interest in the process was for the production of catalytic charge stock having as near virgin characteristics as possible, large samples of the gas oil product were needed for evaluation of its catalytic cracking characteristics. For this purpose an existing pilot unit was converted to a fifty-barrel per day continuous coking pilot unit.

The operation of this semi-commercial pilot unit (Figure 3) in the summer of 1947, in addition to producing large samples of products, was valuable as a means for evaluating alternative methods for charge oil application, coke reheating, and coke flow-controlling devices. There were inherent limitations (inadequate bed depth) in the converted equipment, which necessitated operations being made at temperatures higher than desirable, but the yields and product distribution bore out the results obtained on the smaller pilot plants. Complete evaluations, including catalytic cracking of the products, were obtained in extensive pilot plant investigations on the synthetic crudes produced in the fifty-barrel per day pilot unit.

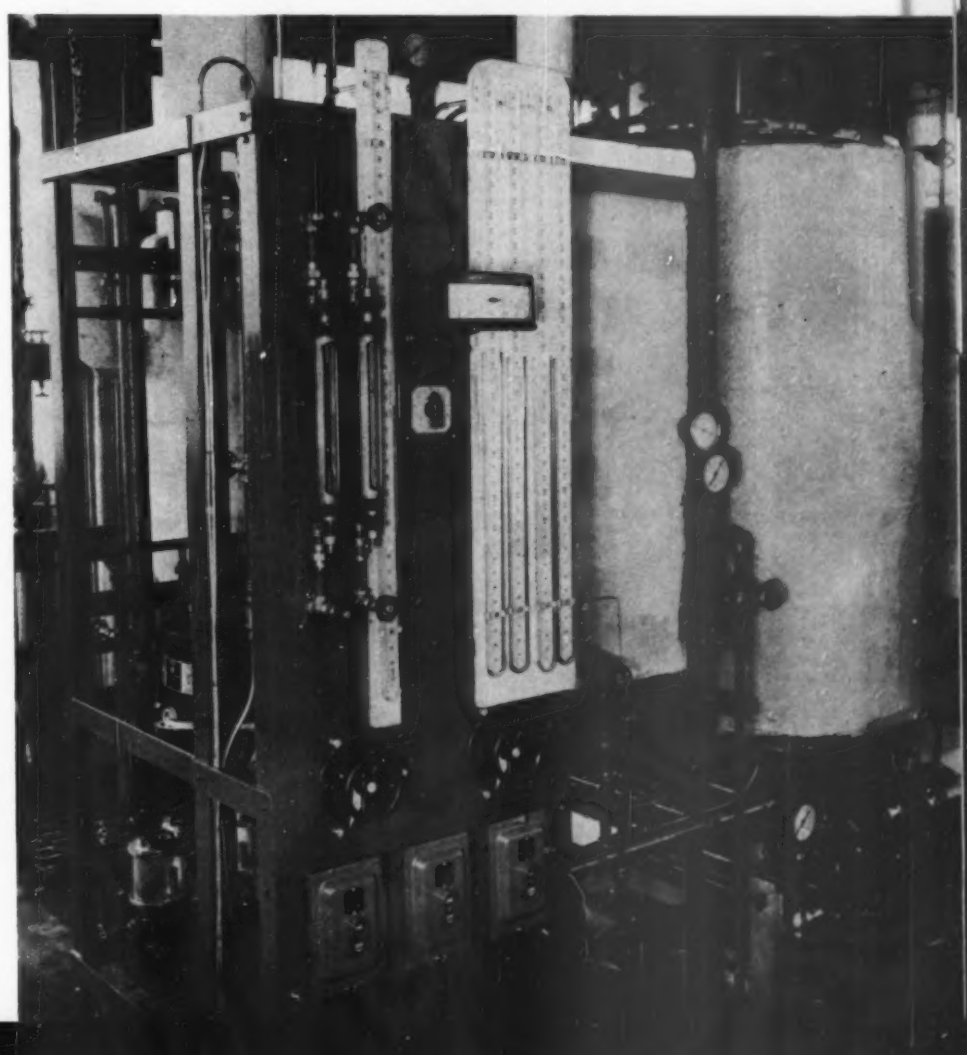
The data from several representative contact coking runs are given in Table I, together with the characteristics of the gas oils produced. These coker gas oils are of near virgin character, as reflected by the characterization factors; they show only a very slight decrease from the characterization factors of the virgin charge stocks. The lighter products show increasing degrees of unsaturation as the molecular weights decrease. Thus, the gases are highly unsaturated, and the gasolines usually run eight to ten octane numbers higher than those from conventional coking and have eight to fourteen points spread between research and motor octane numbers, depending upon the reactor temperature employed.

The results obtained by once-through contact coking of a 30 percent Eastern Venezuela reduced crude on inactive clay and coke are given in Table II. A high yield of gas oil was obtained of near-virgin character and boiling range suitable for catalytic cracking. Correlations of data obtained over a wide range of operating conditions show that the conversion per pass to 900°F endpoint gas oil increases as the average reactor temperature is decreased, provided the reactor volume is sufficient to permit complete coking of the unvaporized oil. The production of dry gas at a given conversion increases rapidly with reactor temperature. The yield of gasoline and the gasoline octane number increase with an increase in vapor outlet temperature and are nearly independent of the type of solids used.

Data from once-through Thermofor catalytic cracking of contact coker gas oil from Eastern Venezuela reduced crude are shown in Table III. The yield of catalytic cracking charge was 71 percent of the original charge to the once-through contact coker, and the overall yields from the combined coking and cracking are shown in Table IV. It will be noted that this processing produced 30 volume percent of debutanized 74 motor octane gasoline and a propane-free liquid recovery of 87 volume percent.

Catalytic cracking data obtained by Fluid cracking of the rerun gas oil from the fifty-barrel per day contact coker runs on Illinois reduced crude are given in Table V. This gas oil produced higher gasoline octane numbers and somewhat higher yields of coke and gas at the same conversion than did a virgin gas oil from the same crude. Allowance in evaluating the data should be made because this coker gas oil was produced under unusually severe conditions imposed by the limited reactor volume in the fifty-barrel per day unit. Unusually high carbon residues were obtained in rerunning this coker synthetic crude after storage for several months. The carbon yield on catalytic cracking is there-

Fig. 2. Control section of two gallon per hour continuous pilot unit.

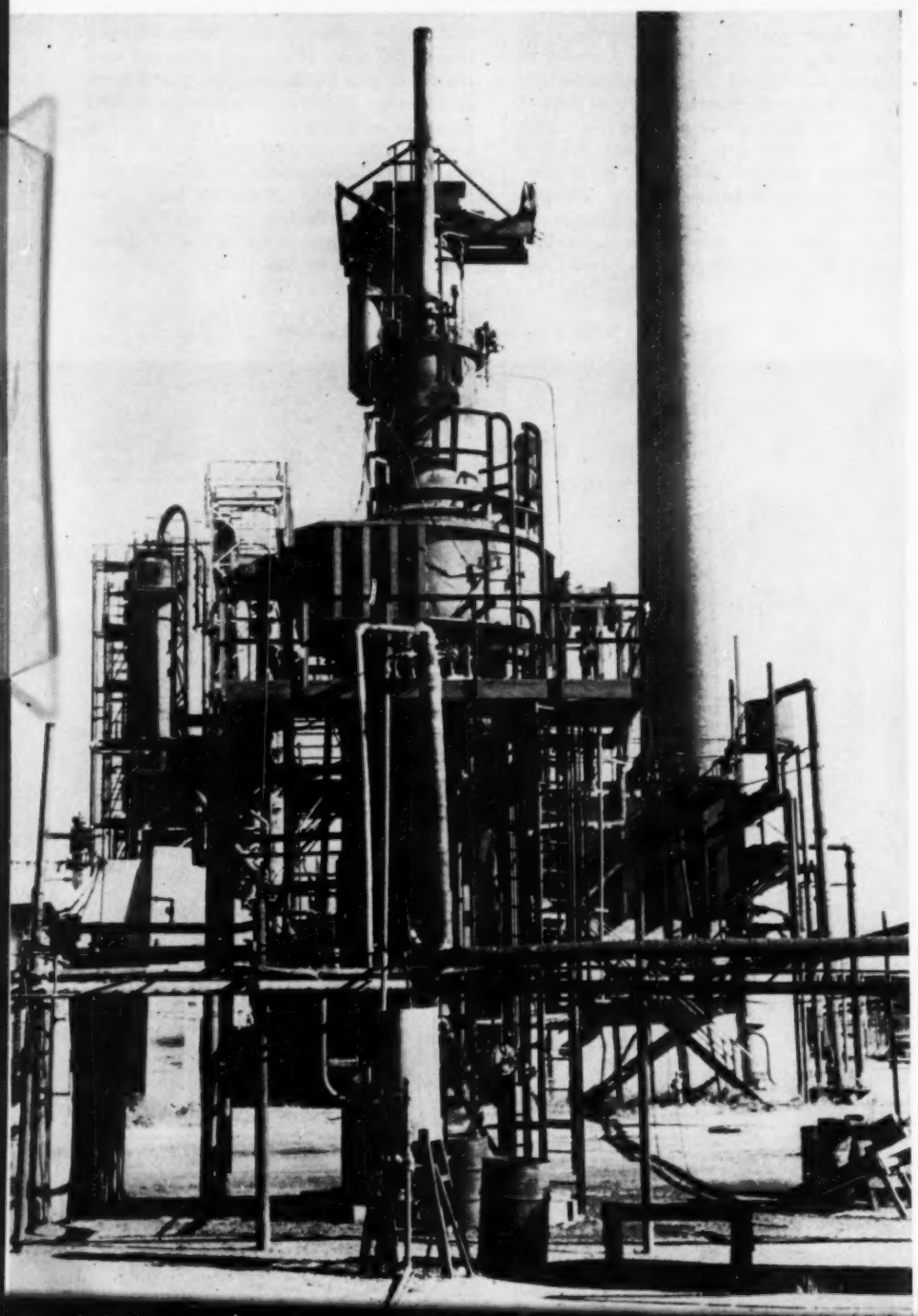


fore higher than would be expected on a combined commercial operation.

The contact coking process produces a coke of ½" to over ¾" particle size, having 1.5 to 5.0 percent volatile matter, 0.5 percent ash, and a bulk density of 58 to 60 pounds per cubic foot. The sulfur content will depend on that of the reduced crude charge. The coke is relatively low in porosity and very high in mechanical strength, individual particles having a crushing strength of 600 pounds per square inch. The burning characteristics of the coke as a fuel have been tested and found to be at least equal to anthracite coal, with the added advantage of low ash content. It is a premium fuel for either domestic or industrial use. For electrode manufacture the low volatile and moisture contents are advantages. Calcining to 0.5 per cent volatile content can be done cheaply and with low loss by providing a calciner on the coking unit and by charging the hot product coke stream to utilize the waste heat in the process.

Complete designs and estimates have been made for contact coking units of 6,500 to 10,000 barrels per day reduced crude charging capacity. A flow diagram showing operating pressures, temperatures, and flow rates for a typical commercial unit is shown in Figure 4. The general arrangement of the reactor and tower structure is shown in Figure 5. In this unit the reduced crude charge is preheated in a conventional fired heater to 850°F and is then thoroughly contacted with the circulating stream of preheated coke particles. The oil-laden coke particles are then introduced into the top of the reactor (D-1) and flow through the reactor as a moving bed. The residence time for the solids in the reactor is 30 to 40 minutes, during which time the hydrocarbon liquid is converted into vapor and dry coke. The coke is deposited as a very thin layer on the original coke particles.

Fig. 3. Semi-commercial scale continuous contact coking pilot unit.



At the bottom of the reactor the coke flows through a specially designed solids drawoff device which maintains uniform flow in the reactor and passes through a vertical seal leg into the top of the coke reheater (BB-1). Here radiant combustion burners supply heat to the circulating coke, and convection heat is also obtained from the resulting flue gases.

From the bottom of the reheater the coke flows by gravity through control valves to the elevator charge inlets. Constant inventory is maintained as coke is produced by continuously drawing off a net coke product stream of the largest particles. The average particle size of the circulating coke is maintained by passing a portion of the circulation through adjustable sizing rolls.

The coke elevators for this unit are standard pressure-type round case elevators of the same type which have given very satisfactory service in T.C.C. plants. The operating conditions in coking service are milder than in catalytic cracking, since no abrasive dust is present, and the solids temperatures are lower than those prevailing in cracking service.

The vapors from the coking reactor are quenched and fractionated in a conventional low-pressure tower to produce gas and gasoline overhead, 400 to 900°F boiling-range gas oil, and bottoms. A 400 to 700°F boiling-range gas oil may be produced, if desired. The bottoms are recycled to the coking reactor to obtain ultimate yields.

A comparison of yields obtainable by contact and delayed coking of two different reduced crudes is given in Table VI for operations aimed at maximum production of gas oil for catalytic cracking charge. The contact coker shows nine to eleven percent higher gas oil yields and lower gas, gasoline, and coke yields than the delayed coker, as would be expected from the lower heater temperatures and minimum vapor cracking characteristic on contact coking operations of this type.

The comparative utility requirements given in Table VII reflect the elimination of the high-pressure decoking water pump in the contact process and the labor savings due to the elimination of the decoking crew.

In various cases where construction cost estimates have been prepared for contact coking and delayed coking, including complete fractionation equipment, the contact coker cost has amounted to a value of 60-80 percent of that for delayed coking. This saving depends on the size of the unit, the use of alloys, and various other factors, and is in general greater for the medium-capacity

units, since the cost of the hydraulic decoking equipment used with delayed coking remains essentially constant, regardless of plant capacity. When the coking section alone is considered, as in cases were coking facilities are to be added to an existing heater and tower system, the savings may be even greater.

TABLE III

Single-Pass Thermofor Catalytic Cracking of Contact Coker Gas Oil from Eastern Venezuela Reduced Crude

Cracking Conditions	
Catalyst	31 Activity Natural
Average Reactor Temperature, °F.	943
Space Velocity, V/hr./V	1.59
Catalyst to Oil Ratio, tons/hr./1000 bbls. oil/day	11.3
Coke Burnoff, lbs./hr./1000 bbls. oil/day	520
Type of Operation	Concurrent-Adiabatic
Product Yields, vol. % of gas oil charge	
Debutanized Gasoline	29.1
Butane-Butene	6.7
Propane-Propylene	5.6
Furnace Oil	27.2
Heavy Gas Oil	33.1
C_3 & Lighter (wt. %)	3.8
Coke (wt. %)	3.9
Cracking Stock Inspections	
Gravity, °A.P.I.	22.8
Bromine Number	21
Aniline Point, °F.	167
Characterization Factor	11.7
Carbon Residue, %	0.03
Vacuum Distillation, °F. at 760 mm.	
10%	579
50%	825
90%	950
Product Inspections	
Gasoline	
Gravity, °A.P.I	53.5
Reid Vapor Pressure lbs./sq. in.	5.4
Aniline Point, °F.	63
Bromine Number	88
Preformed Gum. mg./100 cc.	144
Copper Dish Gum. mg./100	462
Oxygen Stability, minutes	74
Sulfur, %	0.38
A.S.T.M. Distillation, °F.	
I.B.P.	110
10%	140
50%	266
90%	383
E.P.	420
Motor Octane Number, clear	78.6
" " " +3 cc. T.E.L.	82.7
Research Octane Number, clear	90.0
" " " +3 cc. T.E.L.	95.0
Total Gas oil	
Gravity, °A.P.I.	20.1
Aniline Point, °F.	127
Bromine Number	14
Viscosity, S.U.S. at 100°F.	46
Carbon Residue, %	0.91
Sulfur, %	1.15
Vacuum Distillation, °F, at 760 mm.	
10%	477
50%	640
90%	795

TABLE IV

Contact Coking and Thermofor Catalytic Cracking of Eastern Venezuela Reduced Crude[1]

Yields, vol. % on charge to coking unit	
Debutanized Motor Gasoline	30.0
Butane-Butene	6.4
Propane-Propylene	5.9
Furnace Oil	19.3
Heavy Gas Oil	31.3
Gas (C_3 & Lighter) wt. %	4.1
Coke, wt. %	17.3[2]
Octane Number of Combined Gasoline, C_4 Free Motor, clear	74.0

[1] Combined yields from once-through continuous contact coking and Thermofor catalytic cracking of the 30 percent reduced Eastern Venezuela crude.
[2] Carbon residue of reduced crude—13.5%

It will be seen from the compact plot layout for the contact coker that the space requirements are less than for conventional coking plants. The delayed coker requires more space for its decoking water recovery and settling system than the entire plot space for the contact coker.

The continuous contact coker has an unusual degree of flexibility. It can charge any heavy residual stocks that may be available, whereas vacuum bottoms and asphalts are not suitable charges for delayed coking, since they require heater outlet temperatures above 900°. The contact coker is not limited by coking conditions in a fired coil heater, since the stream of circulating coke which largely controls the reactor bed temperature may be maintained at a wide range of temperatures without changing the oil charge preheat. When operating for maximum yield of catalytic cracking charge gas oil the degree of thermal cracking may be minimized in the contact coker by changing the reaction temperature, but if a maximum yield of intermediate boiling-range gas oil is required, the vapor cracking time may be varied independently of the liquid soaking time. Such independent variation is not possible in delayed coking.

If minimum coke yields should be desired, the operation may be carried out at relatively high reactor temperature and low oil partial pressure to obtain a very low coke yield and a small yield of fuel oil. This flexibility may be of advantage in many refinery situations in helping the refiner to meet changes in the fuel oil and coke markets and obtain the most valuable products from the residual stocks currently available.

TABLE V

Single-Pass Fluid Catalytic Cracking of Contact Coker Gas Oil from Illinois Reduced Crude

Run Conditions	
Catalyst	28 Activity Synthetic
Average Reactor Temperature, °F.	926
Space Velocity, W/hr./W (Total Feed Basis)	3.33
Catalyst to Oil Ratio, W/W (Total Feed Basis)	9.0
Slurry Oil Recycle, vol. % of fresh feed	10
Estimated Commercial Carbon Burnoff, lbs./hr./1000 bbls. fresh feed/day	768
Yields, vol. % of gas oil charge	
10 R.V.P. Gasoline	46.5
Excess Butane-Butene	5.3
Propane-Propylene	6.2
Furnace Oil	19.9
Heavy Cycle Stock	21.1
Slurry Oil	5.0
C_3 & Lighter (wt. %)	2.5
Coke (wt. %)	5.8
Cracking Stock Inspections	
Gravity, °A.P.I.	22.7
Bromine Number	18
Aniline Point, °F.	180
Vacuum Distillation 95% Point at 760 mm.	989
Characterization Factor	11.78
Carbon Residue, %	0.73[1]
Inspections of Rerun Products	
Gasoline[2]	
Gravity, °A.P.I.	58.7
Reid Vapor Pressure lbs./sq. in.	10.5
Bromine Number	118
Aniline Point, °F.	64
Preformed Gum, mg./100 cc.	14
Copper Dish Gum. mg./100 cc.	347
Oxygen Stability, minutes	468
Sulfur, %	0.13
A.S.T.M. Distillation, °F.	
I.B.P.	96
10%	119
50%	223
90%	375
E.P.	406
Octane Numbers (Corrected to 10 R.V.P.)	
Motor, clear	79.4
" +3 cc. T.E.L.	82.9
Research, clear	94.3
" +3 cc. T.E.L.	97.7
Furnace Oil	
Gravity, °A.P.I.	22.3
Aniline Point, °F.	72
Sulfur, %	0.83
A.S.T.M. Distillation, °F.	
I.B.P.	414
10%	496
50%	529
90%	589
E.P.	629
Heavy Cycle Stock	
Gravity, °A.P.I.	18.6
Aniline Point, °F.	151
Sulfur, %	0.72
Viscosity, S.U.S. at 130°F.	59
Vacuum Distillation, °F. at 760 mm.	
10%	668
50%	728
90%	788

[1] Coker synthetic crude stored for several months before rerunning. On commercial tower, carbon residue would be 0.2% maximum (see Table III), thus catalytic cracking coke yields are higher than representative.
[2] Inhibited with 10 lbs. U.O.P. No. 5 per 1000 barrels.

Acknowledgment

The writers wish to acknowledge the contributions of the various laboratories for the work done in connection with the development of this process. The isothermal fixed-bed and continuous pilot plant coking runs were made at the Lummus Company Laboratories. The fifty-barrel per day pilot plant was operated by The Standard Oil Company (Ohio) at their Lima Refinery. The pilot plant coking work on Venezuela stocks and the complete evaluation of the synthetic crudes from the Lima pilot unit were made by Gulf Research & Development Company. This included both Thermofor and Fluid cracking of the products.

TABLE VI

Comparison of Contact and Delayed Coking Yields Recycling to Ultimate Yields

Operation	Contact Coking	Delayed Coking	Contact Coking	Delayed Coking
Reduced Crude Charge	Mid-Continent		West Texas	
Reduced Crude Inspections				
% on Crude	26.5	26.5		
Gravity, °A.P.I.	20.6	20.6	14.3	14.3
Carbon Residue, %	8.2	8.2	11.5	11.5
Product Yields, % on Coker Charge				
Gas, Wt. %	6.0	7.0	7.4	7.8
10 R.V.P. Gasoline, vol. %	14.9	21.6	16.9	23.9
Gas Oil, vol. %	75.5	66.5	70.9	59.3
Coke, wt. %	11.5	14.0	15.0	19.3
Gas Oil Endpoint, °F. at 760 mm.	830	830	900	900

TABLE VII

Utility Requirements—Contact and Delayed Coking

Basis: 19,000 barrels per operating day of 18° A.P.I. reduced crude available at 650°F., generating steam from waste heat on coking units.

	Contact Coking	Delayed Coking
Cooling Water, gpm	4,660	8,750
High-Pressure Steam, lbs./hr	None	25,000
Electric Power, kw	210	90
Fuel, millions of btu/hr.	79	115
Labor, operating men/shift	4	10

Aerial view of the Fawley refinery of Anglo-American Oil Co. near Southampton, England, which is to be enlarged to 110,500 barrels daily capacity.

BRITISH MOVING RAPIDLY ON GREAT REFINING PROGRAM

By E. Lawson Lomax

BRITISH motorists are watching hopefully the progress of the broad program of refinery construction in the United Kingdom in expectation that it will hasten the day of derationing, already long overdue in their opinion but maintained because of the government's determination to reduce an unfavorable trade balance by substituting imports of crude for the more costly refined products. Crude imports, of course, can be increased no more rapidly than refining capacity can be provided to handle them. In 1947 they amounted to about 2.3 million tons. In 1948 they rose to 4.5 million tons, representing something less than a quarter of the government's ultimate goal of 20 million tons annually. During the first four months of 1949 crude receipts were about two million tons, indicating a further substantial rise in 1949. Construction now under way or shortly to begin will assure attainment of the 20-million-ton goal by or possibly before 1953.

Most recent event of outstanding interest has been the announcement early in June that work has commenced on the enlargement of the plant of Anglo-American Oil Co. Ltd. at Fawley near Southampton, which will make it the largest refinery in Europe processing 110,500 barrels daily, a throughput of about 5.5 million tons annually. Plans for this important addition to Britain's refining facilities, prepared by the staffs of Anglo American and Esso Development Co., Ltd., have been on the boards for a considerable time, and the project has been under discussion with the British government for two years past. In addition to changes in the existing refinery, the plans call for the erection of nine new processing units. These will consist of a 60,000 barrel per stream day, two-stage crude distillation unit, a 50,000 BPSD single-stage distillation unit, a fluid catalytic cracking unit, a catalytic cracking and crude gas compression unit, a light ends unit, three sweetening units for crude and catalytic cracking of naphthas and an Edeleanu treating unit. The cost of the undertaking is estimated at $150 million, and it is expected that the time required for completion will be approximately three years.

Foster Wheeler Corporation has contracted to construct the plant, providing mechanical design and engineering. It will also erect all off-site facilities except the tankage, marine facilities, administration and laboratory buildings.

As planned at present, the whole output of the new plant, except for a small amount of asphalt, will consist of fuels, including aviation and motor gasoline, special fuels for jet propulsion, diesel oils, kerosenes of all types and fuel oil for land and marine use.

Catalytic cracking is being installed for handling the heavier distillates, but no thermal cracking will be included. Thermal cracking units in the existing refinery will be revamped to act as reforming units for heavy naphthas. The catalytic cracking plant will have a capacity of 33,000 barrels daily. It is exceedingly flexible and, according to the catalyst employed, can be run for high octane gasoline and minimum gas, or can be run for large yields of polymerizable gases and high octane spirit, thus enabling the refinery to cope with any demands for octane rating made on it by market requirements.

As the Middle East crude, which will form the bulk of the oil to be processed in the plant, is high in sulfur, special plant is being installed for its removal. For this purpose an Edeleanu SO_2 plant of 13,000 barrels daily capacity is being erected to treat the kerosene, jet-propulsion fuel and high-speed diesel fractions so as to reduce their sulfur content down to market requirements, and incidentally to improve the burning quality of the kerosene which will be of premium grade. Hypochlorite, doctor, copper chloride and caustic soda will all be used for the final sweetening of the motor spirits and kerosenes, which will insure that these will satisfy the most stringent market requirements. It is not intended to use sulfuric acid as a refining agent for any of the products.

The question of pollution, both aqueous and atmospheric, is a very important one in a refinery of this size, and special measures have been taken to avoid either type.

Electrical power will not be generated in the refinery, such supplies being purchased from the Grid. Low pressure boilers working at 150 psi

gauge will be installed for process steam, and these will be fired by gas or oil, according to which fuel is preferable or available. Sea water will be used for condensation purposes. The fresh water required for steam raising, refining and domestic purposes will be obtained from wells sunk on the property and will be treated before using.

One of the outstanding features of the new refinery is the warehousing and maintenance section, which will be housed in one main structure 180 feet wide by 800 feet long. In this building all maintenance work will be carried out in shops specially fitted for the purpose, where artificial lighting up to drawing-office standard will be installed, as well as mechanical ventilation and heating systems, to insure working conditions being at all times comfortable, either in winter or summer. The building is freely supplied with mechanical lifting gear in order to reduce manual labor to a minimum.

The present docking equipment is being largely augmented to enable the largest sized, modern tankers to be safely berthed either for discharging or loading. Storage capacity for crude oil and products is being increased from the present 1,600,000 to about 6,400,000 barrels, that is, about 60 days' supply, which will cover any risk of tanker breakdown.

During the construction period it is estimated that a staff of 4,000-6,000 will be employed, rising to the latter figure at the peak period of construction, if labor is available. To overcome the local housing shortage during construction, a construction camp to house about 3,000 workers is contemplated, which will be equipped with canteens, recreation halls and other amenities. The present permanent staff of the refinery is about 900, which will be increased to about 2,500 when the plant is on full throughput.

During the past year the two existing refineries of the Anglo-Iranian Oil Co. Ltd. in the United Kingdom, Llandarcy and Grangemouth, both have been increased in capacity by alterations to existing plant and are now undergoing permanent expansion.

The crude capacity of Llandarcy was increased during 1948 from 7,500 to over 20,000 barrels daily, and by the end of 1949 when the new crude plant is completed, it is scheduled to reach 62,000. The $36 million program also includes 1,200 barrels daily of new lube oil capacity, which will raise the total to 1,800. In addition it includes a 3,000-barrel daily SO_2 solvent extraction plant for the refining of kerosene.

At the Grangemouth refinery of Scottish Oils Ltd., the conversion of two thermal cracking units, each of 4,800 BD capacity, for use as crude topping units, has had the effect of raising the crude capacity from 7,200 to approximately 12,000 BD. The expansion scheme now in hand will raise this figure to 42,000 BD. New plant to be added will include a 30,000 BD crude topping unit, a 3,000 BD phosphoric acid alkylation plant and an 8,000 BD copper chloride spirit sweetening plant.

A 10,000 BD catalytic cracking unit is scheduled for erection at a later stage, as well as a new power station, laboratory and administrative buildings. A new tanker berth is to be added to Grangemouth Docks, and at a site elsewhere a new crude unloading system is to be constructed which will be capable of berthing 34-foot draft vessels.

The specialized refinery of Scottish Oils at Pumpherston, of which the primary role is the refining of shale oil, is now also handling the output of the Eakring oilfield in Nottinghamshire, about 1,000 BD.

Site work on the Anglo-Iranian-Gulf project to build a 56,000 BD refinery at the Isle of Grain in Kent is expected to begin this year.

Construction of a new blown asphalt plant for Shell Refining and Marketing Co., Ltd., has now been completed at Shellhaven. It will operate as a continuous process at a capacity of approximately 500 BD. The extensions to the specialty plant for the production of petroleum solvents have also been completed, bringing the capacity for this range of products to 8,000 barrels per month.

The new full-scale refinery at Shellhaven, on which construction work is well under way, will have an ultimate capacity of 3.25 million tons per year. Its cost will be approximately £15 million ($60 million), and the expected date for completion is mid-1953. Engineering design work at the site is approaching completion, and overall equipment and site erection are proceeding satisfactorily. Approximately 1,000 men are employed on the site. The labor hostel has been completed, accommodation now being available for some 460 men. Railway siding work is progressing, and preparations are well advanced for the commencement of work on the cooling water intake tunnel into the River Thames, subject to final agreement with the Port of London Authority.

Construction of the new refinery at Stanlow is more advanced than that at Shellhaven. Much of the civil engineering work has been completed, as well as the concreting of the main refinery roads; engineering design work is also approaching completion, and overall equipment fabrication and site erection are progressing favorably. Piping is arriving on the site, and an early start on the laying of fire mains and other underground pipelines is expected. Progress is being made in construction of storage tanks and other facilities, including the first of the major refining units.

The new Stanlow refinery, with an estimated capacity of 2.5 million tons per year, will cost approximately £15 million ($60 million), and its scheduled date of completion is at the end of 1952.

For both the new Stanlow and Shellhaven plants, Middle East crude from Kuwait will be the main charging stock. The plants and operations involved have been planned in conjunction with Shell's existing refining facilities, particularly to complement present lubricating and bitumen production, so as to insure that a full and comprehensive range of products to satisfy market requirements will be obtained from United Kingdom operation.

The Heysham refinery continues to function satisfactorily after the alterations made to it when it was taken over by the company. Its present capacity is 1.5 million tons per year.

The white oil plant of the refinery of Lobitos Oilfields Ltd., which was reported last year as in course of expansion, has now been completed and is being worked up to its rated throughput of 5,000 tons per year of technical white oils and liquid paraffin. The additional boiler plant also has been completed and is in operation.

Further developments which are going ahead include an extension and reconstruction of the acid treating side of the lubricating oil treatment plant. This involves the provision of equipment for hot acid treatment with subsequent centrifugal separation of acid-tar and oil, for the heavier grades of lubricants. The innovations will enable the oil to be treated at higher temperatures than formerly, with consequent economy in acid consumption, reduction in quantity of acid sludge and an improvement in quality of the resultant finished oils. It is mainly intended for the betterment of the more viscous electrical oils.

Another plant modification which will shortly be commenced is the addition of a further fractionating tower to the Dubbs thermal cracking unit. This tower will enable all of the crude oil to be fed to the Dubbs plant to be preliminarily topped, thus decreasing the load on the present fractionator, which will then handle cracked material exclusively with the result that the capacity of the cracking installation as a whole will be raised by 23 percent.

A very considerable increase in the size of the refinery as a whole, involving the installation of new atmospheric and vacuum distillation plant, is envisaged for the future.

Manchester Oil Refinery Ltd. has broken its previous record this year in production of technical white oils and liquid paraffin, with a complementary increase in its output of petroleum sulfonates and other specialties. A new transformer oil filling and despatch building has been completed, incorporating the most modern apparatus for the handling of transformer oil. The building, which is air conditioned and temperature controlled throughout, is fitted with specially designed drum washing and drying equipment, thus insuring that this type of oil is delivered in a perfectly anhydrous condition.

The Kingsworth and Weaste refineries of Berry Wiggins & Co. Ltd. have continued to work at full throughput during the year, but the large projected increase in refining capacity envisaged last year has not yet been commenced, although the project is still very much alive.

CARTHAGE HYDROCOL PLANT NEARS COMPLETION

FIRST plant for the commercial production of synthetic gasoline from natural gas is being pushed to completion near Brownsville, Texas. Preliminary work of preparing the site, erecting storage and installing the power plant is practically finished. The 63-mile pipeline that is to supply the gas is being laid, and the heavy equipment for the processing plant is being delivered week by week. With the assembling of 1,500 construction workers to complete the task, the refinery is expected to be ready for operation by January 1950, representing an investment of $26,000,000 and introducing a new and important factor into the provision of petroleum and chemical products.

The plant is being built by Carthage Hydrocol, Inc., a company in which nine important industrial concerns are shareholders, these being The Chicago Corporation, Forest Oil Corporation, Hydrocarbon Research Inc., La Gloria Corporation, Niagara Share Corporation, Stone & Webster Inc., The Texas Company, United Gas Corporation and Western Natural Gas Company. It represents the result of research and pilot plant experimentation carried on over the past several years by Hydrocarbon Research Inc. and The Texas Company. The first pilot plant was built by Hydrocarbon Research at Olean, New York, and other pilot plant work was conducted in the pilot unit of The Texas Company at Montebello, California. The present laboratories of Hydrocarbon Research are located at Trenton, New Jersey.

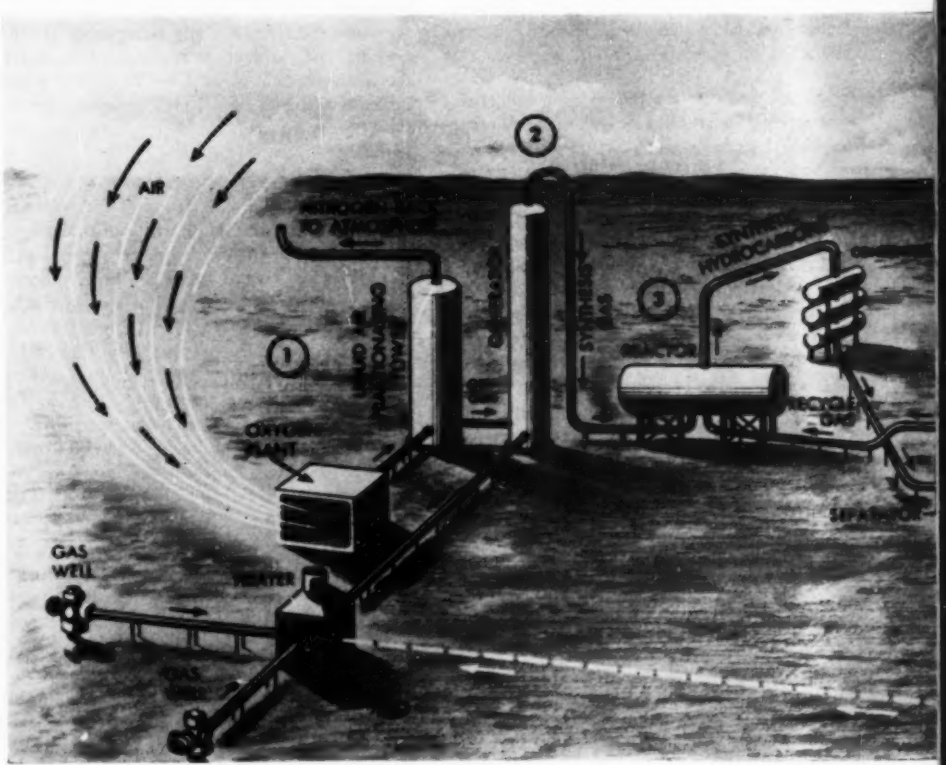
Basic design for the Carthage Hydrocol plant and the design of its specialized equipment have been furnished by Hydrocarbon Research Inc. The engineer contractor is Arthur G. McKee & Co. of Cleveland, Ohio.

In its essentials the Hydrocol Process remains as it was described in the first article on the subject published by World Petroleum in 1946. It includes the separation of high-purity oxygen from air, the combustion of natural gas with the oxygen to produce a mixture of carbon monoxide and hydrogen designated as Hydrocol gas, the conversion of this gas under catalytic treatment into gasoline and other synthetic products, the separation of the gasoline and other products by fractionation, treatment to remove oxygenated compounds, polymerization of propylene and butylene and other established refining steps. In the meantime, however, there have been developments in the way of specialized equipment, in the improvement of catalyst and in other steps contributing to efficient operation.

Efforts to obtain petroleum products by synthesis go back to the early part of the century. Apparently the first successful approach was that of a French experimenter, Paul Sabatier, who found that by passing hydrogen and carbon monoxide over a nickel catalyst, he could obtain methane. When added to manufactured gas from coal, this was capable of improving its quality, but the cost made it commercially prohibitive. Following World War I German scientists turned their attention to the subject and evolved both the Bergius hydrogenation process and the Fischer-Tropsch process. The latter involved the breaking down of coke or braunkohle to produce a mixture of carbon monoxide and hydrogen which, under catalytic treatment yielded gasoline and fuel oil. The Germans worked with low-grade coal because that was the only material available in quantity. Their products were inferior in quality and costly to manufacture, but because Germany lacked oil fields capable of supplying her requirements, synthetic plants were established and supplied a large part of the liquid fuel used by the Nazis in the second world war.

Information regarding German synthetic processes was made known to American oil companies in the mid-twenties, and the Fischer-Tropsch method was investigated by the research departments of a few companies, but the apparent impossibility of developing it to a competitive point in a country well supplied by nature with liquid fuel made study of the subject unattractive.

With the tremendous demand for gasoline and other petroleum products arising from World War II, interest in extending the utilizable reserves from which such products could be derived was awakened. As the result of preliminary studies, natural gas was selected as the most suitable raw material to employ. There were several reasons for this selection, one being that in certain sections of the country natural gas



Simplified flow diagram of Hydrocol plant being built at Brownsville, Texas. →

was plentiful and cheap and that, where pipeline transportation was lacking, there was no other economic means of utilizing it. By using gas, moreover, the processes of mining and treating coal were eliminated.

Even with a reasonably cheap and convenient natural gas supply, the problems that remained were numerous and formidable. To turn out a synthetic gasoline that could be sold in competition with high-grade-fuels made from crude oil in existing refineries, it was necessary to evolve a method of providing cheap oxygen and also to find an inexpensive and efficient catalyst. High pressures had to be dealt with, making it necessary to design special equipment capable of withstanding them. The production of low-cost oxygen was a critical key to the undertaking, and the solution of this problem, which according to report will make it available at less than five cents per thousand feet, is a factor in assuring successful competition at prevailing prices.

As illustrated in the accompanying simplified sketch which is reproduced by permission of Texaco Development Corporation, licensor of the Hydrocol Process, the first step at the Brownsville plant is the withdrawal from the atmosphere of 280 million cubic feet of air per day to be compressed, cooled, liquefied and fractionated to produce 53 million cubic feet of oxygen. The nitrogen separated is discharged to the atmosphere. The oxygen along with 90 million cubic feet of natural gas moves to the generator, a highly important feature of the plant, where it burns to produce Hydrocol gas to the amount of 230 million cubic feet daily.

This synthesis gas goes next to the synthesis unit, where it comes into contact with the finely powdered iron catalyst suspended in the reactors by the upflowing charge gas. Here occurs the chemical reaction which produces synthetic hydrocarbons mixed with water and oxygenated compounds. The latter are drawn off in water solution from a separator and then piped to the nearby chemical plant that is being built by Stanolind Oil and Gas Company for the production of a variety of organic chemicals. The refined chemicals will be marketed by U. S. Industrial Chemicals Inc., which also is building a plant on an adjoining site. The hydrocarbons will be treated by conventional refining methods to yield gasoline and fuel oils. The high heat release in the generator and reactors will be utilized to produce steam in quantities sufficient to drive all the pumps and compressors in the plant, thereby contributing to economy.

Gas supply of the plant will be drawn from the fields of San Salvador, South Weslaco and La Blanca and will be conveyed to the works under high pressure by a pipeline 63 miles long. The gas will be supplied to the line by wellhead pressure, and no compressors will be necessary. Construction of the pipeline, which is now under way, is being done by H. B. Zachry Company of San Antonio, Texas. Starting at San Salvador the line will be made up of seven miles of 12¾-inch diameter pipe, sixteen miles of 14-inch and forty miles of 16-inch pipe. The estimated cost of the pipeline is $1,800,000.

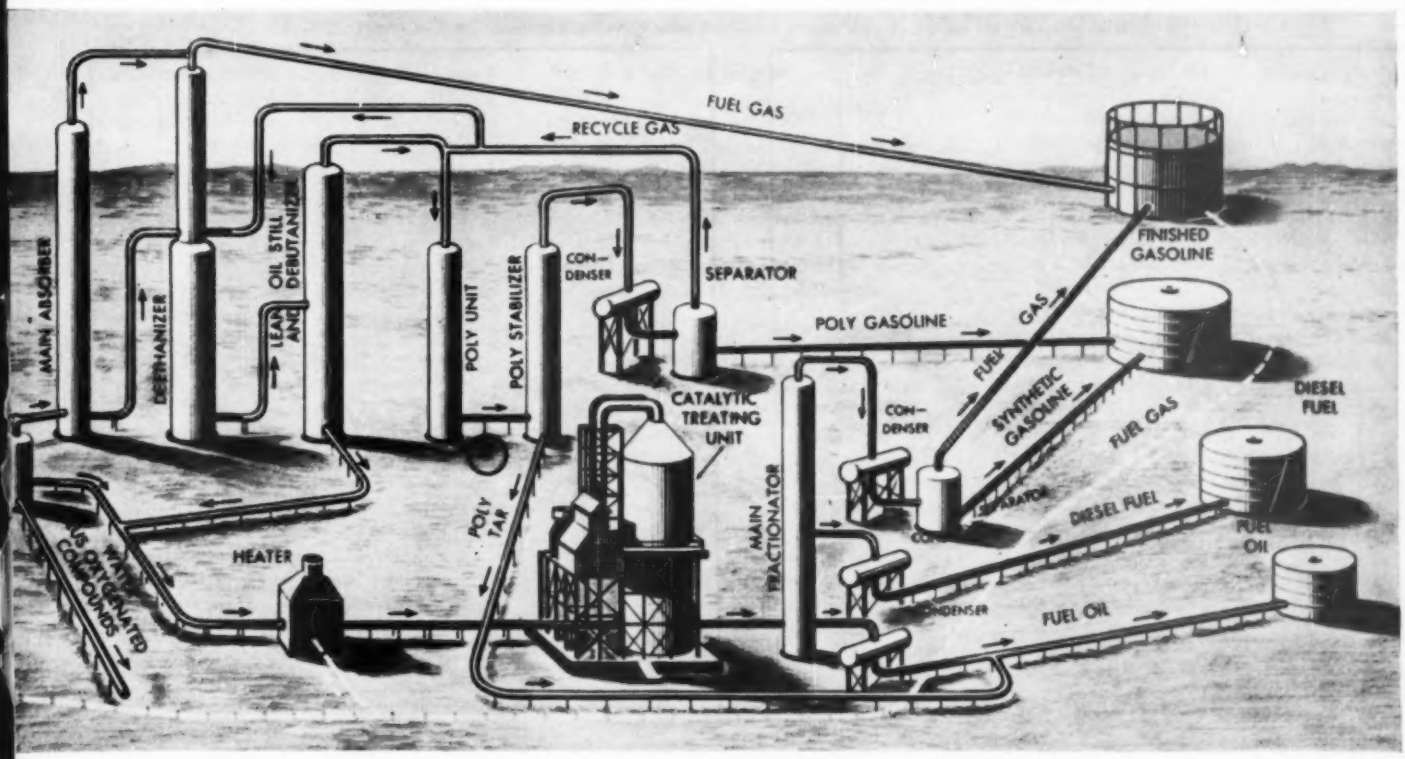
The location of the plant on the Brownsville ship channel, 17 miles from the Gulf of Mexico, will make possible the shipment of products direct from a special dock by ocean-going tankers. The very large cooling-water requirements of the Hydrocol plant, amounting to 120,000 gallons per minute, will be withdrawn from the ship channel.

Calculated daily yields of products are 6,000 barrels of gasoline, 900 barrels of diesel oil, 200 barrels of fuel oil and 300,000 lbs. of chemicals.

Officers of Carthage Hydrocol Inc. are Guy George Gabrielson, president, Frank M. Dawson, vice president, Allen K. Brehm, treasurer, and Albert L. Wolfe, secretary. The operating staff at Brownsville will be headed by R. H. Aitken as superintendent.

Much of the plant's equipment had to be especially designed and constructed to meet exceptional requirements. The oxygen plant compressors, largest units ever built, were supplied by Clark Bros. Co. Inc. Other suppliers of major equipment are Babcock & Wilcox, Combustion Engineering Co., Inc., Crane Co., Foster Wheeler Corporation, Midwest Piping & Supply Co., Inc., A. O. Smith Corporation, Southwest Engineering Co. Inc., Stacey Bros. Gas Construction Co., Worthington Pump and Machinery Corporation and Wyatt Metal and Boiler Works.

Completion of the Carthage Hydrocol plant will mark a milestone in the development of the refining industry and will open the way to an important broadening of the reserves available for the manufacture of petroleum products and chemicals.



Shell refinery at Cardon on the Paraguana peninsula recently began operations. Employee housing area in foreground. Shell photo.

VENEZUELA'S REFINERY PROGRAM MOVES SWIFTLY FORWARD

By Anne Newman Sutton

Maps of eastern and western oil areas showing location of present refineries and those under construction.

REFINING capacity in Venezuela in 1948, estimated at 133,000 barrels daily, represented the charging capacities of the plants of four private companies. Creole Petroleum Corporation, a Standard affiliate, with refineries at Caripito and La Salina, had a capacity of 82,000 barrels daily; Caribbean Petroleum Co. (now Shell Caribbean), with a refinery at San Lorenzo, 37,000; Mene Grande Oil Co., a Gulf Oil subsidiary with topping plants at Cabimas and Oficina, could process 4,000; and Texas Petroleum Co., with a plant at Tucupita, could process 10,000 barrels daily.

At that time four seaboard refineries were under construction and another in the paper stage. Today the Cardón refinery is a magnificent reality; the one at Amuay is nearing completion; the two at Puerto La Cruz show substantial progress, while the one near Maracaibo is still in the preliminary stage. When all these projects are completed, the country's refinery capacity will be increased by about 200,000 barrels daily, making the total figure well over 300,000.

The stupendous project of Shell Co. of Venezuela, Ltd., got under way four years ago with the purchase of 3,300 acres of comparatively flat desert land at Punta Cardón on the extreme southeastern corner of the Paraguaná Peninsula, State of Falcón. What the company has accomplished in this isolated barren waste, where rainfall averages less than 13 inches per year, must be seen to be believed. As W. L. Forster, general manager of the Royal Dutch Shell Group in Venezuela, said on May 7 at the official inauguration of the new 50,000-barrel refinery, it is one of the greatest engineering works ever undertaken in Venezuela and, of its kind, perhaps the work of greatest scope to date in the history of the petroleum industry. It has cost some $150,000,000, and as the company has decided to spend $30,000,000 more on additions and improvements in order to increase refining capacity to 90,000 barrels daily, it probably will be the largest and most complete oil refinery in Latin America. It will then refine about 7.5 percent of the country's oil.

The ambitious enterprise under the direction of C. P. Louwerse, a dynamic Dutchman, was a snarl of problems from the beginning, and each problem had more facets than a high-class diamond. Geography offered difficulties to begin with, for the wind-swept peninsula of Paraguaná is remote from centers of population, the nearest town of any size being Coro on the mainland over 60 miles away. Lack of roads and water increased difficulties of transportation; scarcity of expert technicians and of suitable materials during and after the war caused exasperating delays, and there were the usual innumerable problems of human relations that arise when hundreds of unskilled workmen from the local population have to be educated to do a job. With patience and time these problems have been solved, and the project planned in detail on paper now approaches reality on land.

There are five distinct areas, all of which merge harmoniously in the general plan and allow room for expansion. These are the port area, the refinery proper, the area of auxiliary services, water supply and the residential community.

Fortunately Cardón has a natural harbor about 50 feet deep. A small pier for moving materials was built for temporary use until two new piers, each approximately 1,475 feet long, could be constructed. These are thoroughly modern, and each provides two berths for lake tankers and two for vessels of deep draft. To these piers comes crude from Zulia's oil fields, and from them go refined products to Venezuelan and foreign (mainly European) ports. Over them move materials and foodstuffs for refinery and community. Nearby is the Maritime office.

The refinery proper, which went on stream at the beginning of February or a year and a half ahead of obligation, contains the following processing equipment, now operating:

Two-stage (atmospheric and vacuum) crude distillation unit and Ethyl blending plant

Before year's end the following processing equipment will be in operation:

Two UOP thermal cracking units
UOP thermal reformer
High-vacuum distillation unit
Pressure distillate redistillation unit
Gastail (cracked products separation)
Two Gasoline treating plants (1 acid; 1 "Doctor")
Catalytic polymerization unit
Lube oil plant

Besides these, there will be added installations for mixing tetraethyl lead with gasoline, preparing caustic soda solutions and solutions of litharge and recovering petroleum from waste water. An alkylation plant (sulfuric acid process) will also be added.

The plans call for four separate tank farms. Already constructed are 17 tanks, each of 70,000-barrel capacity, for crude oil. A second tank farm is for fuel oils, a third for gas oil and diesel oils, and a fourth for gasoline, kerosene and naphtha. Each of these three last-named farms has its intermediate tanks as well as a certain number of finished storage tanks; also each has a separate pump house for blending operations and for ship loading.

The area of auxiliary services contains an electric power plant, a steam plant, warehouses and workshops. The electric plant has a total capacity of 30,000 KW, but only three units of 7,500 KW each are now in operation. The steam plant has two high-pressure and two low-pressure boilers now operating. The four large warehouses at Cardón contain over 40,000 items ranging from nails to intricate machinery. Among the workshops are those for mechanical construction and repair, garages and auto repair, carpenter shops, furniture making and repair, shops for brick and pipe manufacture and other industries that are musts for comfortable living.

Water supply is a three-way triumph. An installation of powerful pumps circulates and cools sea water to be used in the refinery and for protection against fire; another modern unit removes the salts from ocean water to give it domestic use and make it drinkable; and the numerous pipes stored in the open under a rainless sky are mute evidence of the enormous aqueduct that will soon be built to import potable water in quantity. Since Cardón is a short distance south of Amuay where the Creole Petroleum Corp. is constructing a 60,000 barrel refinery, the two companies will have a joint 30- and 34-inch gravity-flow water line from Siburua in the San Luis Mountains southeast of Coro, State of Falcón. It will extend some 62 miles and then bifurcate to the refineries. For its construction, now under way, the line will require 20,000 tons of steel and will cost $10,000,000. It will be the largest and longest aqueduct in Venezuela and will supply about 9,500,000 gallons of water daily.

Pier at Shell's Cardon refinery. Shell photo.

The area for community and residence, planned to accommodate upward of 10,000 people, reveals the same geometrical neatness as seen elsewhere. Houses, widely spaced to allow for gardens and privacy, are built on parallel curving streets. Some 600 are finished already, and almost as many are under construction or projected. Other buildings already completed include several schools, a church, club, laundry, dry cleaning establishment, beauty and barber shops, incinerator, pharmacy, market, restaurant and police barracks. Two shark-netted bathing beaches are in use, as are also baseball and football fields and a cricket pitch. There is also an open-air cinema with seating capacity for 1,200 people. The Plaza Bolivar, located in the heart of the community, was dedicated last October, and parks, well laid out, are waiting to be planted. Presently under construction are a commissary, hospital and clinic, and a club for junior staff.

Present accomplishment is a concrete monument to the 6,500 men who labored to bring it about, and it is a convincing sign of the company's faith in Venezuela's future. Cardón has been a progressive school in which thousands of nacionals have been trained in the use of modern implements and machinery, have been taught to man-

ufacture many of the materials needed and have become skillful in numerous crafts. As a result they will be more valuable as citizens of the Republic and will be able to give their children better opportunities.

Another colossal project that has contributed greatly to Venezuela's economic prosperity is also on the Paraguaná Peninsula, about seven miles north of Cardón on Amuay Bay, site of Creole's new 60,000-barrel refinery, now nearing completion. This project, started in October 1946 when surveys were begun and a temporary beachhead made, probably will be operating by December 31 of the current year, or one year ahead of obligation.

This enterprise, now estimated at a cost in excess of $175,000,000, is similar in scope and magnitude to that at Cardón, except that here a harbor had to be made by dredging about five million cubic feet of soil. As a result, ocean-going vessels may be admitted to the large materials pier with oil-handling facilities and to the two oil-handling finger piers, all three of which have been completed and in operation for nearly a year. These are of steel and reinforced concrete and will accommodate six ocean-going vessels. Also of reinforced concrete and steel is the 1100-foot approach trestle to the main dock. A permanent power house has been erected to replace temporary power facilities used to furnish electricity during plant construction; more and better roads have been built, and more tankage has been constructed.

Total tankage between the crude terminal and the refinery amounts to some five million barrels. Tanks are of varying capacities. There are 28 tanks of 150,000 barrels each and numerous small tanks.

The refinery, when completed, will consist of one atmospheric and one vacuum grade distillation unit and an asphalt plant. Cutback and oxidized asphalts will be produced by the asphalt plant, and the other two will produce gasoline, solvent naphtha, kerosene, diesel oil, lube distillate, heavy cracking stock and fuel oil. The refinery at Amuay will have greater crude capacity than that at Cardón, but Shell's plant will turn out more grades of products.

Approximately 4,500 employees, of whom only seven or eight hundred are expatriates, are living at Amuay now. Employment will be at the peak this fall when it is expected to exceed 6,000. Contractors for the crude still and asphalt plant are George F. Driscoll & Company; for the power plant and other auxiliary construction, J. G. White Engineering Company. W. J. Connelly, in charge of Creole's refinery activities, estimates that 1,800 men will be required to operate the plant. Crude oil is now being brought to the terminal from the Maracaibo oil fields through the new 24- and 26-inch Ule-Amuay pipeline, a $48 million project completed last December.

Potable water is still imported by tanker from Puerto Cabello, although standby evaporation plants are there to derive fresh water from ocean brine if necessary. To date, these plants, which are surplus war units capable of compression distillation, have been used but little. Water for drinking and domestic uses will be piped in from Siburua as already stated. Creole has three 150,000-barrel tanks for water storage.

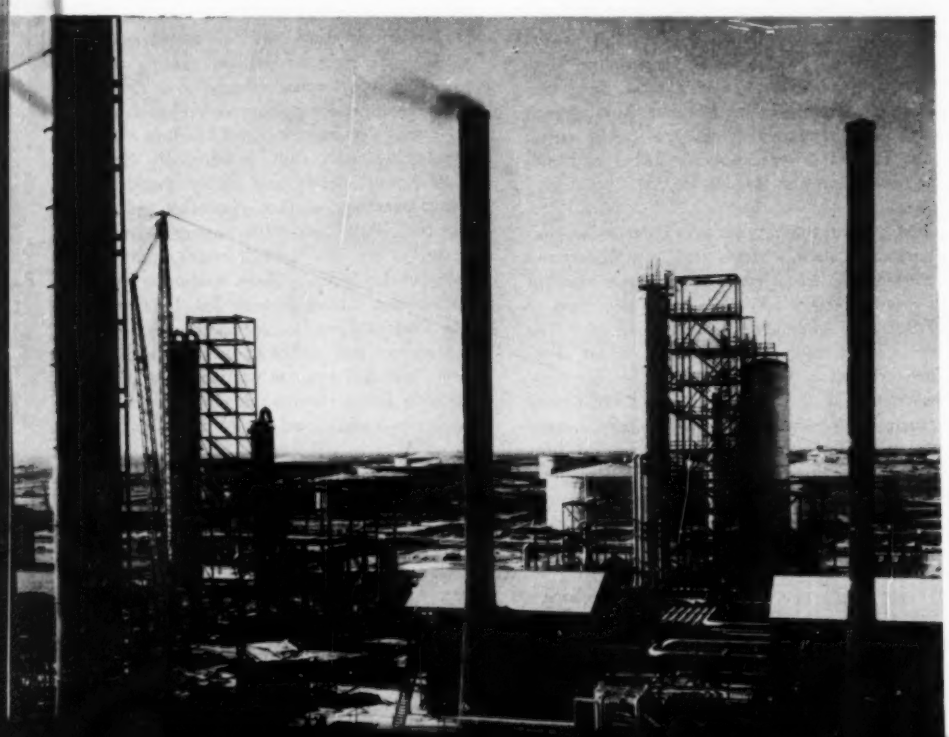
As with Shell, Creole has acted on the theory that the best possible life for its employees will bring the best possible results. Consequently, considerations of health and sanitation, of esthetics and efficiency, have been stressed in both theory and practice, and the people who live in these remote, man-made oases are healthy and happy.

It is safe to predict that the $50 million refinery project of Venezuela Gulf Refining Co. at Puerto La Cruz will also be completed ahead of obligation, or before December 31, 1950. The refinery, in which Texas Petroleum Co. will have a 35 percent interest, is being designed to process 30,000 barrels daily of crude oil, and the crude distillation plant will be capable of processing an additional 10,000 barrels of crude per day. Principal products will be gasoline, kerosene, fuel oil and naphtha. Most of the crude will come from fields in eastern Venezuela via pipelines already in operation. Practically finished now is an extension of Mene Grande's oil-loading wharf which will provide sufficient berthing space for shipment of refinery products and crude. Substantial progress has been made on all refinery units; the housing program, which provides for permanent houses to accommodate 4,500 people, will be finished by the end of the year; and a pumping and treating plant for river water will be finished in the autumn. Construction will reach its peak next August or September when some 4,000 workmen, mostly nacionals, will be employed. Refinery units are being built by Lummus; construction is by Raymond-Hegeman.

By Dec. 31, 1950, Sinclair Oil and Refining Co. will have a new refinery with a charging capacity of at least 35,000 barrels at Puerto La Cruz. William Gullette is in charge of the project. As of June, 54 permanent houses had been built and 84 more were under construction. Also completed or under construction are a power plant, hospital, schools, theatre and warehouses. Frederick Snare Corp. are the general contractors. In addition to the eight 80,000-barrel tanks built last year by Chicago Bridge & Iron Co., eight more of 150,000 barrels each have been added, six of 20,000 barrels each, and numerous miscellaneous tanks. Water will come from the Neveri river in an eight- and ten-inch pipe and will be treated to make it drinkable. Necessary product loading lines are being added to the pier.

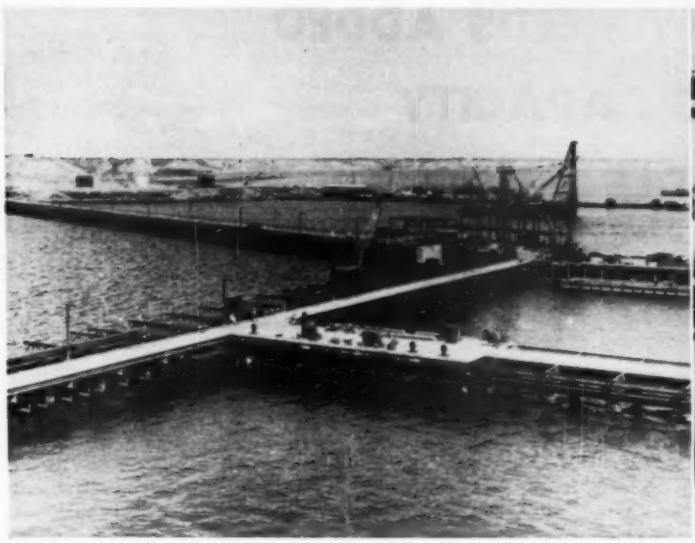
Richmond Exploration Co. (Standard of California) plans to construct a 35,000-barrel refinery south of Maracaibo to process heavy crude from the Boscan field. Further plans have not been released. Venezuela Atlantic Refining Co., Phillips Oil Co., S. A. Petrolera Las Mercedes, and Caracas Petroleum S. A. will be under obligation to construct refineries if and when their 1944 concessions yield enough crude to make such construction practicable.

It is evident, then, that upon completion of all these projects, Venezuela will become an important processor of crude oil, will ship substantial amounts of finished products to foreign markets in addition to supplying home needs, and thus will strengthen the national economy.

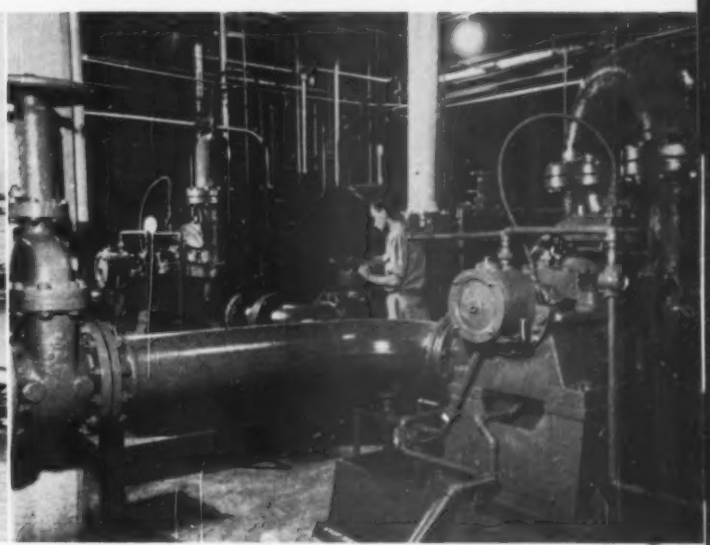


Photograph taken during construction of the distillation equipment at the Cardon refinery. Crude still is at the right. Shell photo.

Amuay bay, Paraguana, where Creole Petroleum Corp. is building its large new refinery. Creole photo.



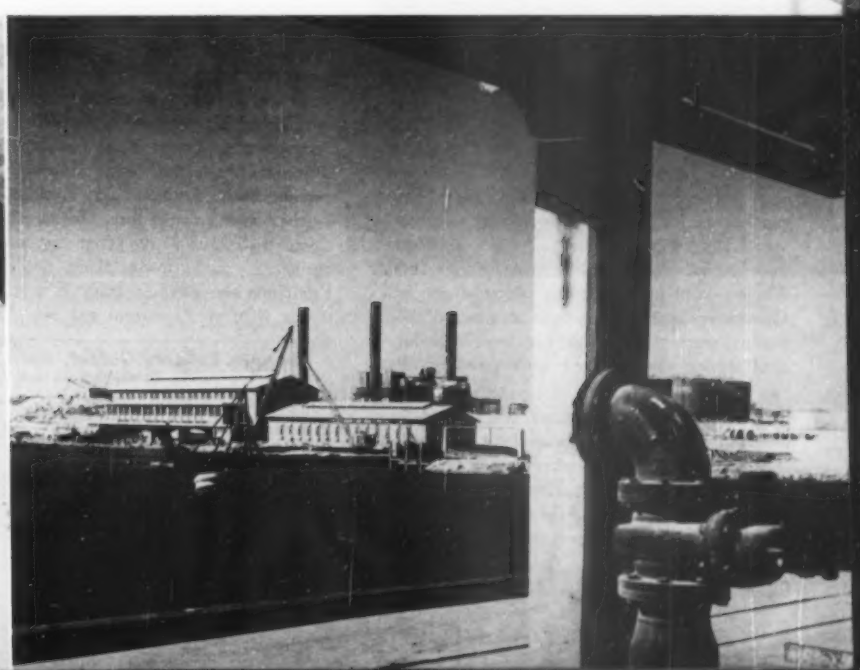
Main pier at Amuay bay, terminus of Creole's new 285,000-barrel pipe line from Lake Maracaibo. Creole photo.

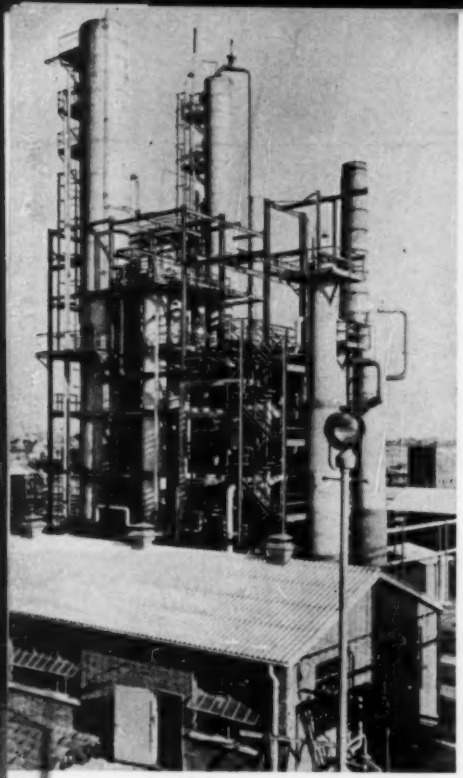


Pumps in the salt water pump house employed to pump cooling water throughout the Cardon refinery area. Shell photo.

Crude lines in Creole Petroleum Corp. tank farm at Amuay bay. This tank farm has a storage capacity for 2,500,000 barrels of oil. Creole photo.

Power plant area at the Cardon refinery as seen from Jetty No. 1. Salt water pump house and power house and part of the boiler plant are visible. Shell photo.





Furfural plant of the Gewerkschaft Deurag-Nerag at Misburg near Hanover.

GERMANY NEEDS ADDED REFINING CAPACITY TO HANDLE RESIDUES

By Alfred Stahmer

AT the close of the war the German refining industry was practically non-existent, all facilities having been destroyed or put out of operation by persistent bombing. By rebuilding, partly with salvaged equipment, throughput capacity was brought to 9,500,000 barrels per year in 1947. By more extensive reconstruction it will be raised to something like 36,000,000 barrels by the end of this year.

A substantial part of this, about 14,000,000 barrels, is topping capacity only, but with a full refining potential of 22,000,000 barrels it will provide sufficient petroleum products for western Germany at the present rate of supply, which is fixed by the occupation authorities at 17,200,000 barrels for the fiscal year 1949-50.

A serious setback to the anticipated expansion of refining capacity was the reversal by the military government of its original decision to permit two prewar hydrogenation plants to go into operation, using crude oil or residues as raw material for processing into petroleum products. These two plants, Wesseling near Cologne and Gelsenberg in the Ruhr, built at a cost of $20-million, were of large size, had been little damaged during the war and were standing idle.

To put them back into service, it was pointed out, would give employment to workers and would save dollars that would otherwise be spent for imported products. Operating permits were granted to both plants. At the time the fear of a shortage in petroleum was widespread. Later on the supply of oil became plentiful, and at the conference of foreign ministers held at Washington in April it was decided to let the Wesseling plant continue working but to abandon the Gelsenberg project. This decision was a hard blow to the Gelsenberg proprietors who had invested 17 million marks on the strength of the permit issued six months earlier and who had 3,000 laborers employed. As a consequence the import of gasoline which had been scheduled to end in March had to be resumed to meet requirements.

The Gelsenberg Benzil company prepared a report in which it was claimed that the hydrogenation process for the treatment of oil residues was nearly as economic as cracking. According to this statement the gasoline yield from Aramco crude by combined distillation and hydrogenation amounts to 92 percent against 71 percent from distillation and cracking. Thereby the higher costs of the hydrogenation process, calculated at 155 marks per metric ton of crude against 30 marks for cracking, are eliminated. From one ton Aramco crude it was computed that a yield of 51 percent gasoline, 30 percent liquefied gas and 38 percent diesel oil could be gained by topping and treatment of the residue by the hydrogenation process. This corresponds to 30 percent gasoline, 3.0 percent liquefied gas, 38 percent diesel oil and 24 percent fuel oil by distillation plus cracking. With full utilization of the hydrogenation capacity of Gelsenberg, which would be increased to 3.8 million barrels yearly, as compared with the production permit of 1.26 million barrels, the amount of foreign exchange which could be saved was placed at $20-million yearly.

German Refinery Output, April 1949
(in metric tons)

Liquefied gas	729
Gasoline	32,901
Kerosene	5,988
Diesel oil	30,549
Lubricating oils	21,108
Bitumen	10,322
Fuel oil	19,936
Other products	7,776
Total	129,309

The second Rhenish hydrogenation plant, Wesseling near Cologne, is by a special paragraph of the Washington agreement excluded from the general prohibition of the synthetic industry. While Gelsenberg had arranged for close cooperation with the Deutsche Vacuum Oel AG and the Deutsch-Amerikanische Petroleum-Gesellschaft, affiliates of Socony-Vacuum and Standard Esso respectively, Wesseling has a similar contract with the Deutsche Shell AG. After repair the plant started distilling operations in March of this year and began hydrogenation early in April. Wesseling is expected to treat 2.5 million barrels of Kuwait crude or 2.8 million barrels Aramco crude yearly. From an intake of 2.5 million barrels Kuwait crude, Wesseling is estimated to produce 1,500,000 barrels of gasoline, 100,000 barrels of liquefied gas and 700,000 barrels of diesel oil. In addition an output of about 5,000 metric tons of synthetic ammonia and 3,000 metric tons of methanol monthly is expected at Wesseling.

The outstanding rebuilding operation of this year for normal refining facilities is that of the Shell Group in Hamburg-Harburg, where 3,000 laborers are rebuilding the plant, which was the largest German refinery before the war. Operation is scheduled to begin in October next. The first stage of the program was finished by completion of dewaxing and furfurol extraction units at the end of May. A refining capacity of 9,000 barrels daily of Arabian crude will be provided by the Harburg plant. Besides gasoline, white spirit and diesel oil, high viscosity lubricating oils and bitumen are to be produced.

Good progress also is being made by the German affiliate of Socony-Vacuum, the Deutsche Vacuum Oel AG, which has two refining plants, Bremen-Oslebshausen and Wedel on Elbe. Vacuum erected a 9,500-barrel-daily topping unit at Bremen-Oslebshausen, which, apart from the existing lube oil refinery at Oslebshausen with a capacity of 2,300 barrels daily, is adding a considerable operating potential to the Vacuum plants.

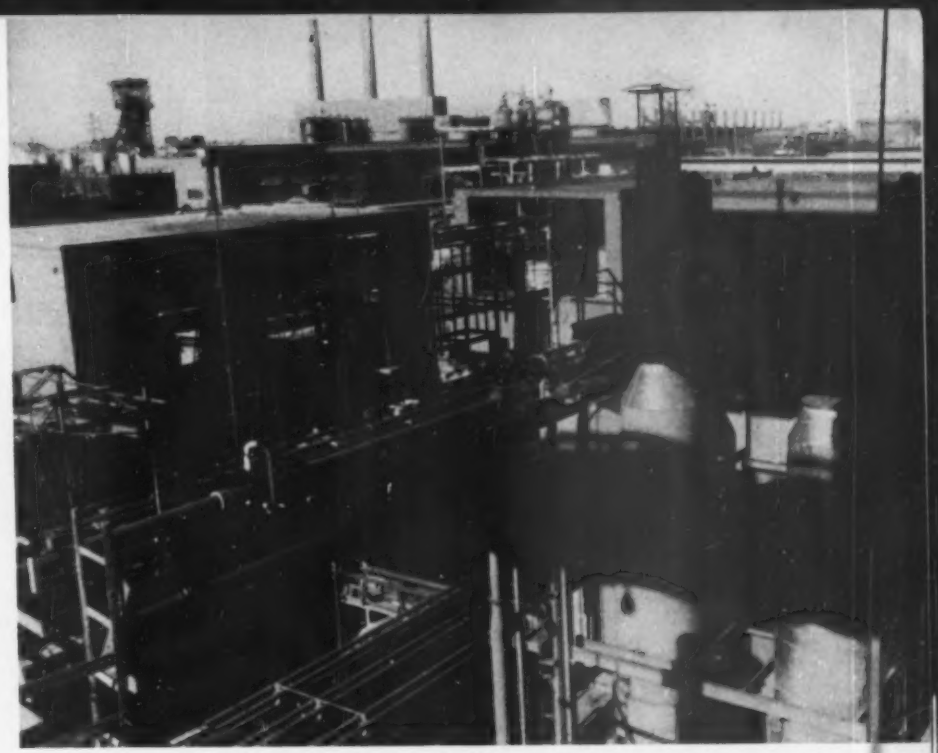
Two of the three distillation units of the Ebano Asphalt-Werke in Hamburg-Harburg (Standard Esso) with a total throughput capacity of 10,000 barrels per day are now in operation. The third, of 3,500-barrel daily capacity, will be put in action as soon as possible. Besides, to complete its facilities Ebano has ordered some gasoline refining units. At present the distillates are delivered on contract to other plants for further treatment.

In February of this year the Eurotank refinery in Hamburg-Finkenwerder, formerly owned by Davies & Co., and now in possession of Anglo-Iranian Oil Co., resumed operation. Eurotank has an intake distillation unit for treating 3,500 barrels daily. A cracking plant of 5,800 barrels per day was heavily damaged by air raids but is expected to be reconstructed in the first half of 1950. At present Eurotank runs for British account, the output from imported crude being re-exported to the United Kingdom.

In the Hanover area the refinery of Gewerkschaft Deurag-Nerag at Misburg near Hanover has installed a new Edeleanu plant. Misburg is, as before, engaged especially in the treating of indigenous German crudes.

In Hamburg-Grasbrook the Deutsche Erdoel AG is reconstructing a dewaxing and selective plant to handle lubricating distillates coming from the refineries of the DEA at Heide, Holstein and Wietze. The installations come partly from the former Wilhelmsburg plant of the DEA, which was largely destroyed during the war. The intake capacity of the new plant, which will be ready at the end of this year, is 1,500 barrels of distillates daily.

The growing amount of imported crude, according to the planned increase of supplies on one hand and the rising output of indigenous crude on the other, call for the construction of more refining capacity in Western Germany, the more so as Gelsenberg is being abandoned. The main problem is how to gain sufficient capacity for the handling of residues. Germany, being a coal country, has no large market for fuel oil; likewise the German crude is poor in gasoline and diesel oil. For both these products the former refining capacity was inadequate. Under these circumstances cracking facilities for providing more light products from the residues are urgently required for the western German refining industry in order to enable it to meet all demands. The leading oil companies in Germany have plans for the building of such cracking units. Most of them concern installations which shall adjoin existing refineries. Two projects concern the erection of new refineries with extensive cracking facilities.

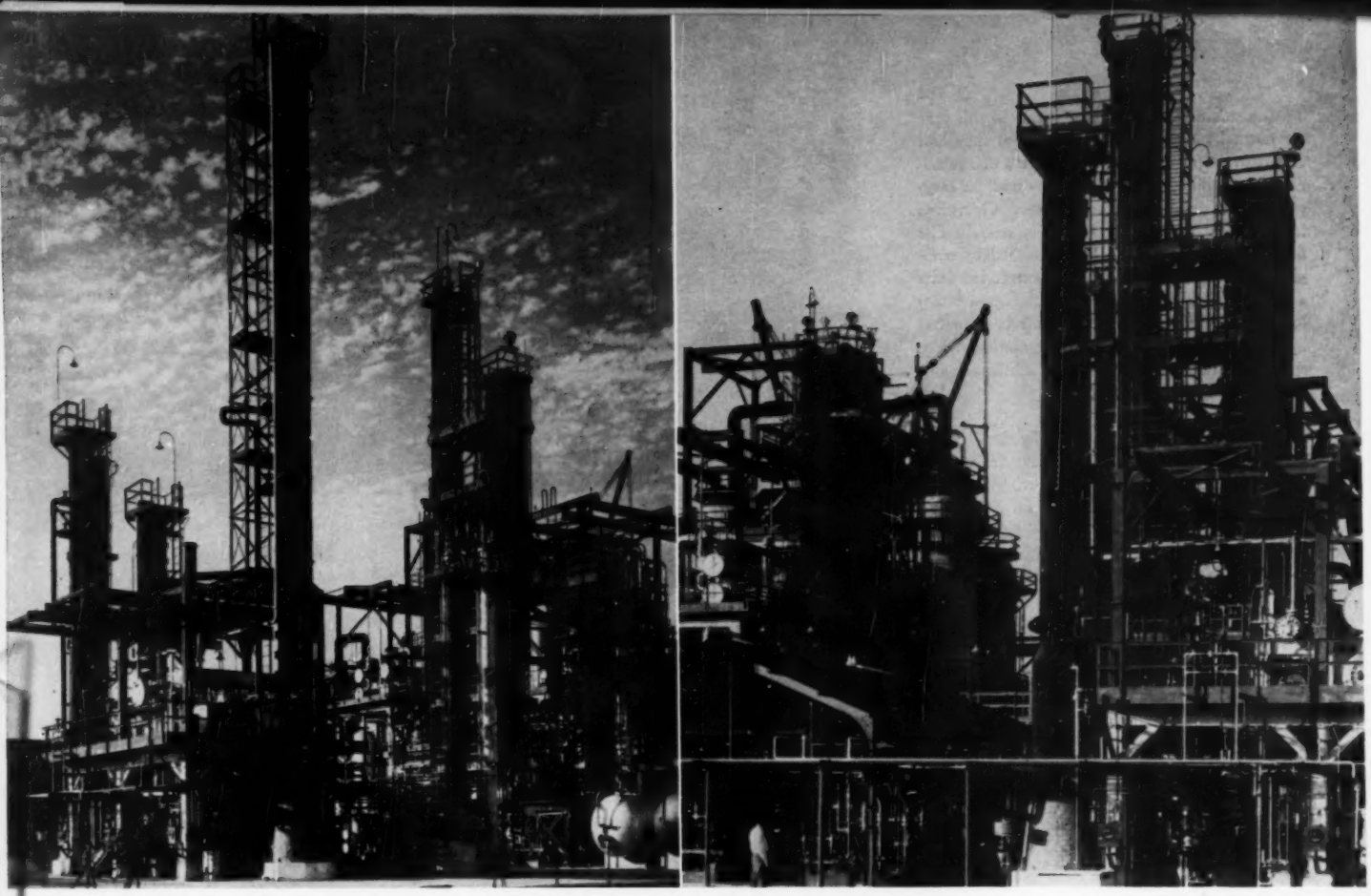


Gelsenberg hydrogenation works near Gelsenkirchen in the Ruhr area which is said to obtain a gasoline yield of 92 percent from Saudi Arabian crude.

In respect to the increasing crude output from the Emsland fields, Gewerkschaft Elwerth and Wintershall AG, the chief owner of Emsland oil concessions, plan to build a refinery with cracking capacity of 2,800,000 barrels yearly near Lingen town (Emsland) on the Dortmund-Ems canal which links the Ruhr area with the North Sea. The second scheme is jointly proposed by the Deutsche Erdoel AG (DEA) and the Hamburger Mineraloel-Werke Ernst Jung. It is proposed to erect a modern plant with cracking units at Stadersand (Lower Elbe river) with a crude intake of approximately 2,800,000 barrels annually. The site chosen already contains a large tank farm of nearly 600,000 barrels capacity, with discharging facilities for seagoing tankers, pipelines and pumping plant of Mineraloel-Werke Jung. It is intended to work on imported as well as on German crude from the DEA fields in Holstein and Hanover.

It is not yet clear whether eastern Germany, up to now separated by the iron curtain, will be unified again with the western zones in the near future. If this should happen, the refining industry of western Germany would have the task of increasing production further for supplying a market which is far undernourished at the present.

Coal bridge to the boiler plant in course of reconstruction at the Shell refinery at Hamburg-Harburg. (Shell Photo).



Two views of the Houdry catalytic cracking plant of Cie. de Raffinage Shell-Berre.

FRENCH REFINING POLICY AIMED TO FIT NATIONAL NEEDS

By Henry M. Ballande
Vice Chairman, OEEC Oil Committee

IN continuing the restoration of the plants that were seriously damaged by the war, and in setting up the bases for a reasonable development for the near future, the French refining industry during the past year has acquired new faith in its vitality.

Out of the 13 refineries which it was decided to keep in operation or to rebuild after the war, 10 were able to treat, between June 1, 1947 and May 31, 1948, 45,678,000 barrels of crude. One other which was in course of repair, treated 643,000 of topped crude. During the past 12 months, from June 1, 1948, to May 31, 1949, these 11 refineries treated a total of 73,650,720 barrels. The refinery that was still under repair (the plant of the Socony-Vacuum Francaise at Frontignan) began to receive crude in October 1948 after a "sealine" was laid.

Compared with the preceding year, the national production (Pechelbronn oil field in Alsace) remained practically stationary and negligible. On the other hand the French participation in the Iraq Petroleum Company appreciably decreased (3,224,920 barrels instead of 6,218,220 barrels); this was due to military operations in the Near East which led to a shutdown of the Kirkuk-Haifa pipeline in the spring of 1948.

The breakdown of this tonnage by origin is given below:

Table I

		Barrels	Percent
Middle East	French participation in Iraq Petroleum Co.	3,224,920	4.4
	Other origins	54,793,300	74.4
Western Hemis.	U. S. A.	1,760,460	2.4
	Venezuela	12,465,300	16.9
	Other origins	1,015,280	1.4
Production of France proper		391,460	0.5
Total		73,650,720	

On the financial side, the imports of crude represent an expense of $98,302,000 in U.S. currency and $64,700,000 payable in pounds sterling. Here acknowledgment should be made to the program of European Recovery and to the generous aid of the American people, who literally saved French industry and transportation from strangulation by taking upon themselves the entire dollar expense, and in addition, from June 1, 1948, to May 31, 1949, they paid $28,132,300 for the importation of finished products, and $59,774,400 for petroleum freights. This was an inestimable contribution to the recovery of France and to the cause of world peace.

Note may be taken of the increased percentage of fuel oil (47 percent against 34 percent in 1938) which resulted from the general use of refinery methods designed for obtaining the best quantitative yield with the existing set-ups. By employing most of the cracking units for topping

purposes, it was possible to exceed, practically without new installations, the tonnage of crude that was treated before the war (50,830,600 barrels in 1938). The supplemental production thereby obtained in 1948 reached 207,120 barrels of automobile gasoline, 3,700,000 of gas-oil, and 10,999,000 barrels of heavy fuels. This undoubtedly contributed greatly to make up the power shortage which delayed for several years the recovery of the French economy. On the other hand, the quality of the automobile gasoline had to be kept on a relatively low level, but a change in this respect is planned. The octane number of automobile gasoline was raised two points in March 1949 and is now 68 at the pump, with a maximum content of 0.5cc of tetraethyl lead, the average being hardly 0.4cc.

Refinery Output by Products

Propane	5,469 metric tons
Butane	46,558 " "
Gasoline	18,170,612 barrels
White spirit	263,489 "
Jet fuel	92,500 "
Kerosene	2,444,841 "
Gas-oil	8,377,259 "
Fuel oils	30,680,500 "
Bitumen	321,090 metric tons
Lubricants	1,432,530 barrels
Paraffin	5,400 metric tons
Petrolatum	2,015 metric tons
Other products	13,031 barrels

At the beginning of 1950 the octane number of gasoline will be raised to 70. Thus the French refineries have been able to satisfy during the past 12 months almost the whole of the needs of metropolitan France and Algiers (91.2 percent). The progressive reduction of the import of finished products has decreased to a considerable extent the lack of balance in payments in strong currencies, and, therefore, has decreased the amount of aid required of the ECA. A certain part of the refining capacity could even be put at the disposition of foreign companies by "processing agreements." These contracts have amounted to about 9,600,000 barrels, which is 13 percent of the total throughput. A large part of the finished products has been delivered as bunker fuel to foreign ships or shipped to the nearest overseas territory (Tunis, Morocco), the proceeds of the operation being used either for the purchase of oil equipment in the United States or in paying for a complementary quantity of crude oil in the sterling zone.

It should be emphasized that the refining capacity affected by these processing agreements should not be considered as the result of an ex-

Tankage under construction at Port Jerome plant of Standard Francaise des Petroles.

Crude Run by French Refineries

(Thousands of Barrels)

	1948	1949
January	3,161	6,701
February	3,574	6,170
March	3,503	7,041
April	5,411	5,980
May	6,211	8,033
June	5,210	
July	5,859	
August	5,462	
September	4,683	
October	5,542	
November	5,527	
December	7,077	

cessive development of the French refining industry. This capacity is really not available, in that the French government has been obliged, due to the lack of strong exchanges, artificially to reduce the consumption of petroleum products. During the period under consideration, the base ration of the 600,000 automobilists who did not have priority was practically suppressed (limited to an average of 1.3 gallons per month, whereas each one of them consumed an average of 22.2 gallons a month in 1938). Rationing by coupon has been kept in force for all the other petroleum products, and the giving out of new authorization for consumption of fuel oil is done only with the exercise of a "great prudence."

It is probable that these processing agreements will not be extended beyond June 30, 1949. The capacity of the French refineries now appears nearly sufficient to satisfy the needs of metropolitan France and French North Africa during the fiscal year 1949-50. This plan will call for treating about 96,200,000 barrels of crude. There will still remain certain important direct imports of finished products, such as aviation gasoline 100-130, quality lubricants, waxes, and petroleum coke.

The development program for the French refining industry, as it has now been shaped up for the next three years and presented to the OEEC and the ECA, rests on the same principle. Its aim essentially is to refine in France a tonnage of crude oil equal to the needs of metropolitan France and its overseas territories, including the bunkering of French ships in French ports. This formula calls for a throughput of 385,000 barrels daily. It is well understood that there is to be no significant exportation to the more remote overseas territories. In any case the consumption of these territories represents only a small fraction of the total (about 14,000 barrels daily), and it is thought that it can be covered by a process of adjustment. The companies that supply these markets also have refineries in France and outlets in the neighboring European countries.

In the French refinery program a distinction should be made between the part that corresponds to modernization of the installation, and the part that has in view an extension of capacity.

The need for modernization is imposed by changes that have occurred since the war in sources of crude oil and in the relative importance of gasoline consumption as compared with consumption of fuel oils. The refineries should be able to treat the Near East crudes, extract therefrom the maximum of lubricants and paraffin, obtain a high proportion of gas oil and fuels and produce an automobile gasoline of world quality. This implies an adaptation or a replacement of the material destroyed during the war, and in the case of France, this represents, in fact, the main part of the refinery equipment program and a considerable proportion of the dollar credits expected of the ECA (more than 60 percent).

The modernization program also contemplates the development of a chemical industry based on petroleum. Such an industry in France will aim at the production in 1953 of the following amounts: Detergents, 46,000 metric tons; Acetone, 27,000 metric tons; and Ethylene derivatives, 24,000 metric tons.

Four new companies have been organized for this purpose by agreements between long-established concerns that have specialized in the chemical industry and companies engaged in oil refining. They also contemplate the production of carbon black and ammonia. The total of this production will require an annual supply of about 2,000,000 barrels of petroleum products.

The extension of capacity (properly so called) is justified by the necessity of reducing, by all possible means, the cost of refining in terms of strong currencies. For long years the French economy will have to endure a severe shortage of hard money. It must be recognized that the number of dollars that France can devote each year to the purchase of petroleum products will be strictly limited, because there must be established a difficult balance between the imports of all goods that are of prime necessity—a balance in which there will be no flexibility. A country which wishes to make a comeback by its own means without appeal to such provisional and exceptional foreign aids as the ERP must obtain the best possible return from the reduced means of payment at its disposal. It seems that such a policy will not run against the interests of its suppliers, but rather the contrary, especially when these latter occupy a front position in the country's industry. It is known that the French companies which include American interests control about 30 percent of the total capacity of 385,000 barrels daily that is called for in the French program for 1953.

Compared with the refinery programs presented by the other European countries within the framework of the ERP, the French program is distinguished by the following characteristics. No new plant is to be built. The work contemplated will be included within the limits of the 13 existing refineries. For this reason the investment per ton of capacity will be the least.

The expense in dollars will be appreciably smaller than that of countries presenting a program of comparable importance.

It should be emphasized that the French government has used its own authority to reduce to 385,000 barrels daily the original projects for a capacity of 493,200 barrels daily presented by

Le Havre terminal of Cie. Industrielle et Maritime.

the companies for 1953. This reduced program has an objective limited to satisfying the needs of the French Union and, except for the lack of strong exchanges mentioned above, does not prejudice possible exports to nearby countries.

Twenty-one years ago France adopted an extensive refinery policy and demonstrated by facts that she had the technical and financial means, and for all the cited reasons it is to be expected that the objective and reasonable character of her program will be recognized and appreciated.

Provence refinery near Marseille of Cie. Francaise de Raffinage. Photo copyright by Les Prises de Vues Aeriennes, Paris.

ITALY BUILDS LARGER REFINING INDUSTRY

By Antonio Giordano

IMPORTANT progress has been made during the past year in the reconstruction of Italian refineries and in plans for added capacity through new construction and expansion of existing plants. In the Adriatic region, as the result of a combination between Anglo-Iranian Oil Co., Ltd., and Azienda Generale Italiana Petroli (AGIP), the Industria Raffinazione Olii Minerali (IROM) has completed rehabilitation of its Venice refinery, which is now operating with a crude charging capacity of 5,800 barrels daily and a cracking capacity of 3,100 barrels daily. Arrangements have been made for the installation of a catalytic cracking unit which will provide added capacity.

At Trieste the Standard Italo-Americano del Petrolio (SIAP) has completed reorganization of its Santa Sabba refinery with a daily crude capacity of 2,500 barrels, while the Aquila Societe Tecnico Industriale has raised its capacity to 140 percent of its prewar rating under the reconstruction program started in 1946. Arrangements have been completed for installation in the refinery of a lubricating oil unit for the production of about 25,000 tons annually of a full range of lubricants from Middle East crude. Completion of this unit is expected by 1951.

Early in the year Standard Oil Co. (N. J.) acquired an interest in Azienda Nazionale Idrogenazione Combustibili (ANIC), as a result of which there will be an enlargement and technical reorganization of the ANIC refineries at Leghorn and Bari with an increase in capacity to 16,000 barrels daily and elimination of the hydrogenation equipment at the latter plant. Details of the changes proposed have not yet been made public.

At Fornovo Taro near Parma, Societa Petrolifera Italiana, subsidiary of Standard Oil Co. (N. J.), for several years past has operated a small refinery to process oil from the field located there, the only producing field in Italy. Production is small, only about 4,500 tons yearly, but the oil is of good quality, yielding a high proportion of light products, and is free of sulfur. Since the war the plant has been reconstructed to turn out specialized products, and the company is in position to supply a good share of Italy's requirements of solvents.

Reconstruction of the Naples refinery of Socony-Vacuum Oil Company is nearing completion. Its capacity is being doubled to 16,000 barrels daily by installation of cracking equipment.

In addition to the reconstruction of previously existing refineries, the Italian Ministry for Industry and Commerce has authorized three new plants among many applications received. One of these is for a plant of 40,000 barrels daily to be built by the Italian subsidiary of Royal Dutch Shell at Apuania, north of La Spezia, where the company already has a plant. The Apuania refinery is to produce high-octane motor spirit gas oil and lubricants.

Another authorization is for a refinery at Trecate (Novara) on the Ticino river, to be operated by Societa Anonima Raffineria Padana Olii Minerali with an initial capacity of 13,000 barrels daily. The capital of this company is in the hands of Petrocaltex, the combination founded in Turin between the Fiat Company and Caltex. According to statements to your correspondent by Marquis Teodolo Teodoli, chairman of the Italian Caltex, the plant is expected to specialize in the production of high-test gasoline. It will be connected with the ocean terminal of Petrocaltex at Vado Ligure (Savona) through a 155 km pipeline with a diameter of 200 mm and a capacity of 7,000 barrels per hour at a pressure of 60 atmospheres. According to report, construction will begin early in 1950 with completion scheduled for 1952.

A third project which has received ministerial approval is that of CONDOR S.p.A. per l'Industria Petrolifera e Chimica. The plant as projected is to have an annual capacity of over one million tons and is to produce high-octane gasoline, white spirit, kerosene, gas oil, diesel oil and several types of fuel oil. A site of three hundred acres has been acquired by the company near Rho on the outskirts of Milan with road and rail communications in every direction. Crude oil for the refinery will be pumped from Genoa by a 100-mile, 10-inch line. The site of the refinery at Milan is considered competitively advantageous, being in the center of the province of Lombardy and having within a radius of fifty miles about 25 percent of the Italian market for petroleum products.

Dr. Franz Kind, well known European refining expert, has been an active factor in developing the plans for CONDOR. While it is an independent company, CONDOR, through its shareholders and board, will have close relations with Manchester Oil Refinery Ltd. in England and with AQUILA in Trieste, with which Dr. Kind is also connected.

For the first time Sicily is to have a refinery. It is being established by Raffinerie Siciliane Olii Minerali (RASIOM) at Augusta. The unique feature about this plant is that it is being transported bodily from its former location at Longview, Texas. The entire equipment is being dismantled by Delta Engineering Company of Houston, moved on flatcars to a Gulf Coast port, loaded into steamships and reassembled on the site prepared for it in Sicily. The refinery, originally of 7,000 barrels per day, will be stepped up to a capacity of 10,000 barrels in the new location. The refinery will operate on Middle East crude.

Further expansion of Italian refining is more or less involved with the general oil situation. In the postwar discussion of the handling of Middle East oil, Italians argued that their country offered a strategic location for its refining, midway between the fields and the markets of western Europe. Italy was ambitious also to develop domestic production, and several international companies have shown a readiness to engage in exploration. Such action depends, however, on modernization of the Italian mining law which has been promised but not yet made effective. At the same time there is agitation in Italy for the establishment of a monopoly on the sale of oil and gas products, with prices fixed by the government. Should such action be taken, it would result undoubtedly in the withdrawal of American interests and probably in the suspension of ECA aid to Italy.

Toward the end of 1948 the government decided to liquidate the Comitato Italiano Petroli (Italian Petroleum Board), which had been in control of refining during the 1946-1948 period. This permitted the refiners to work out a program of independent activity during 1949 based roughly on the following figures, shown in metric tons per year:

	Motor Spirit	Kerosene	Gas Oil	Fuel Oil
ANIC	140,000	48,000	261,000	228,000
Aquila	62,400	24,000	93,600	164,400
Shell (La Spezia)	104,400	24,000	67,200	162,000
IROM	108,000	30,000	97,600	234,000
Socony-Vacuum, Naples	56,000	45,000	79,200	114,800
Esso—Trieste	12,000	16,800	2,400	48,000

Rebuilt distillation equipment of the Trieste refinery of Standard-Italo Americana Petroli. Esso photo.

ELECTRICAL POWER TRENDS IN MODERN REFINERIES

By J. M. Crothers*

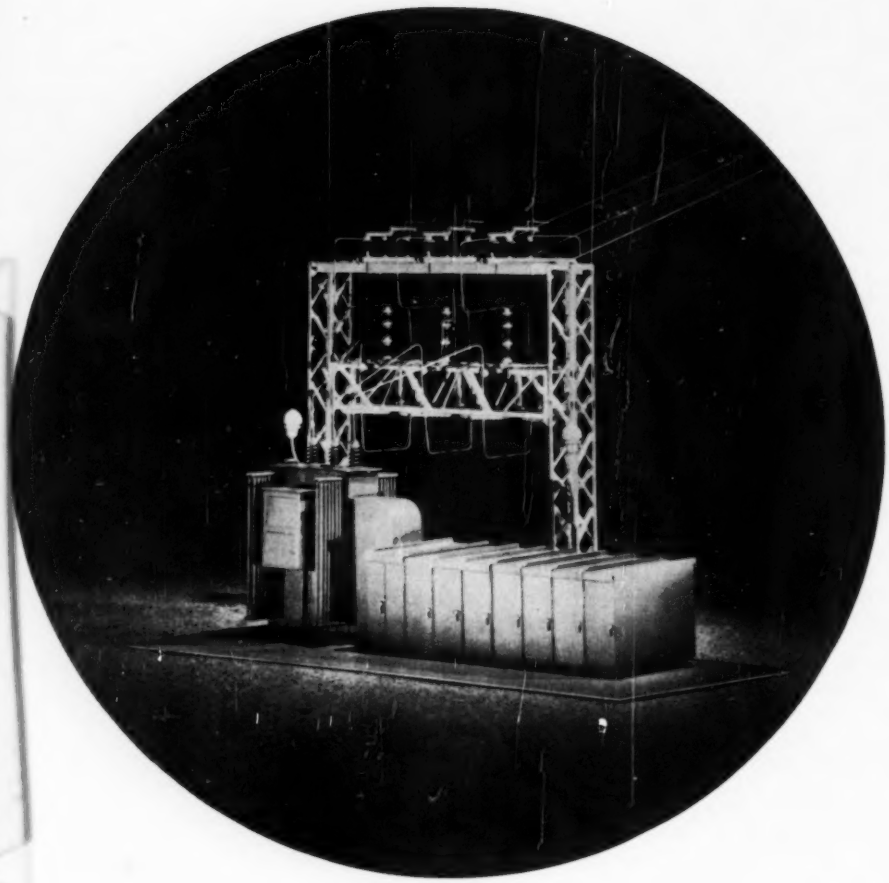
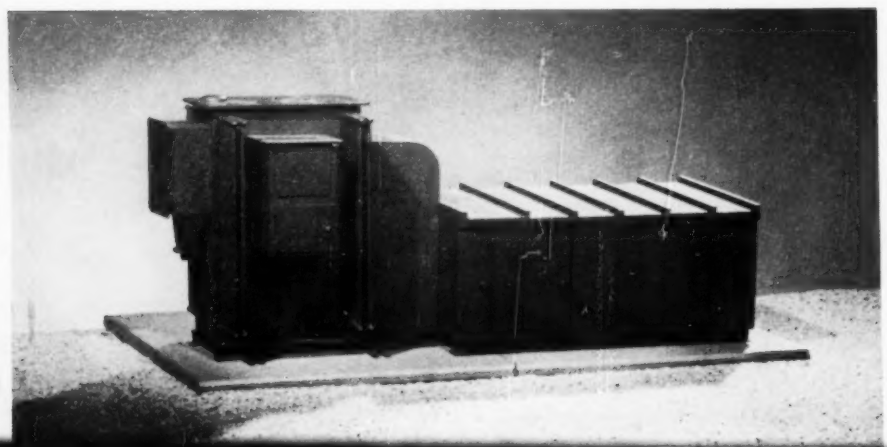


Fig. 1. Prefabricated substation with overhead high tension feeder.

Fig. 2. Prefabricated substation with high tension feeder installed underground.



IN recent years electric requirements in oil refineries have increased in direct proportion to advances in petroleum processes and increased production. Refiners are demanding continuity of incoming service more than ever before because of the necessity of keeping units on stream. In many cases this consists of main and emergency feeders equipped with high-speed throw-over devices. Serious consideration is made of future expansions, and the selection of equipment is based on flexibility of application and increases in capacity at a minimum of expense. Unit substations and packaged switchgear often prove the most economical installation, although the initial cost may be higher than the cost of the various components. The prefabricated units of standard manufacture save greatly in engineering, drafting and field assembly.

The selection of primary and secondary voltages is of prime importance and is determined after a careful study of all existing and probable future requirements. Average size refineries now use 2,300 volts for primary distribution and 460 volts for secondary power. Odd voltages, phases and cycles are avoided where possible because standard equipment is always more readily available. Refineries having many motors larger than 100 horsepower and heavy loads at various distances from the power source use 2,300 volts with transformers located at concentrated load-centers to serve 440-volt motors, lighting and instruments. This is done to reduce copper losses and improve voltage regulation. In smaller refineries few motors over 100 horsepower are installed and are usually located within relatively short distances of the power source. Here 460 volts serve most motors, and reduced voltage starters are used where a large motor, having excessive starting currents, would seriously affect voltages.

Substations are, where possible, located in non-hazardous areas, convenient to the power source and load. Consideration is given to substation expansion without interference with future refinery expansion. Many substations are now purchased as complete prefabricated units as illustrated by Figures 1 and 2. In Figure 1 the high tension feeder is overhead through protective fused disconnects. In Figure 2 the high tension feeder is installed underground. In the equipment shown in both illustrations, provision is made for increasing the number of outgoing feeders. The entire unit is weatherproof and buildings are not required. They are set on prepared foundations and only the outgoing feeder

* Catalytic Construction Co., Philadelphia, Pa.

cables are installed and connected by field electricians.

Transformer capacities are determined by converting total operating horsepower requirements, plus estimated lighting loads and probable plant expansions into KVA. Uneconomical expenditures are made when a complete transformer installation must be replaced by one of larger capacity in a short period because careful consideration was not given to future plant expansions. Many refiners install dual transformers and feed cables for primary power and consider the extra expenditure good insurance against losses caused by entire plant outages for the time of repair to a transformer or cable. Transformer dependability has increased to such an extent that many prefer three-phase units instead of single-phase units at a substantial saving in capital outlay.

Switchgear interrupting ratings are chosen to clear all system faults of maximum currents delivered by transformers with sustained normal voltages on primaries with consideration given to future requirements. The interrupting ratings are cascaded from source to utilization point and time settings are arranged to clear individual circuits without affecting others.

Main plant distribution feeder cables in underground duct are probably used more extensively than any other method due to reliability, although of higher initial installation cost. The cables are subjected to less lightning disturbances and mechanical injury and are well protected from flash fires often encountered in various parts of refineries. Repair and maintenance costs are reduced, and often manholes are purposely filled with water to eliminate gas pockets and reduce fire hazards. Aerial cables with messenger and spun lashings are now available and are being investigated by many engineers.

Package unit motor starter switchgear recently has been installed by many refiners. These are custom built to the purchaser's specifications and can be obtained with required lighting transformers and welding supply switches, completely wired except for the outgoing and incoming wires. Figures 3 and 4 illustrate two types of packaged switch racks. Figure 3 is a motor starter rack with incoming line switch and combination air-break starters, entirely explosion-proof and waterproof. Figure 4 shows a similar arrangement using oil-immersed, explosion-proof and weatherproof equipment. The above switch racks are also made non-explosion-proof for non-hazardous locations, and all conduits entering or leaving the rack are sealed against the passage of vapors or gases. Motor starters of 2300-volt, employing current-limiting fuses for short-circuit protection are readily available for non-hazardous locations but cannot be classified as entirely explosion-proof. In order to reduce the percentage of hazard, many refiners specify all connections and arcing points at least six inches under oil with adequate sealing compartments for all wires entering or leaving the starters. Oil-filled fused disconnects are often used in place of current-limiting fuses to eliminate arc in the surrounding atmosphere. Figure 5 illustrates such a starter with the oil-filled fuse cutouts in the top compartment and the oil-immersed starter in the bottom compartment. These can be made in various arrangements having a common bus and incoming line unit.

Power factor correction is frequently accomplished by the installation of capacitor units assembled in suitable housings with proper protective devices paralleled on the main bus at the substation. Small individual capacitors in parallel with motors are seldom used in refineries because of the usual large number of standby motors and hazardous areas encountered.

The breakdown of any link in the chain of power distribution, from source to motor control of important drivers such as fuel charge pumps, water pumps, etc., or the loss of electrical service to the instruments, is of major importance to the on-stream period. Consideration should be given to the fact that the electrical installation of an average modern refinery ranges from two to six percent of the total expenditure, and the differences in cost between a poor and excellent installation is relatively small.

Fig. 5. Motor starter unit with oil-filled fuse cutouts in the top compartment and oil-immersed starter in the bottom compartment.

The picture presented by the general trend of electrical installation in modern refineries is of clean-cut, totally enclosed, outdoor, weatherproof, package type equipment supplied by underground main feeders of higher initial cost, insuring a minimum of repair and maintenance and maximum of on-stream periods.

Fig. 3. Packed motor starter switch rack with combination air-break starters.

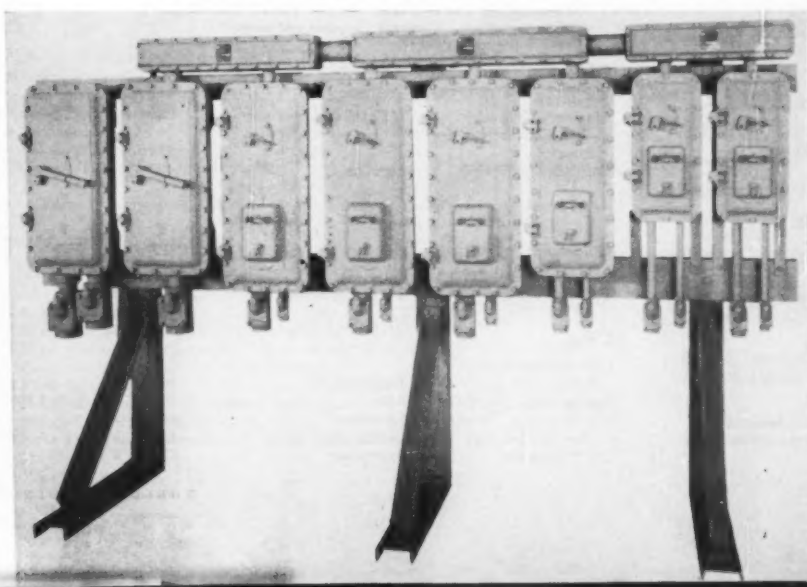


Fig. 4. Motor starter rack using oil-immersed, explosion proof and weather proof equipment.

OIL REFINERIES OF THE WORLD

The tabulation below has been prepared to show the present capacities and status of oil refineries outside the United States where such information is available. No data is given on U.S.S.R. plants. In nations dominated by the Russians data is not up to date. Capacities are in barrels per day. Key to type of plant: S-Skimming; L-Lubricating; A-Asphalt; C-Cracking; Comp.-Complete; T-Topping.

Name of Company	Plant Location	Crude Capacity	Type Plant	Cracking Capacity
Argentina:				
Cia. Nativa de Petroleo	Campana (B.A.)	17,500	SCLA	9,100
	Bahia Blanca	4,000	SCA	2,200
	Embarcacion	1,000	S	—
	Plaza Huincul	400	S	—
Cia. Petrolera Astra	C. Rivadavia	2,200	S	—
Condor	Avellaneda (B.A.)		SL	—
Diadema Argentina	Dock Sud-Avellaneda (B.A.)	12,000	SC	9,000
Ferrocarrilera de Petroleo	C. Rivadavia (Chubbut)	8,000	Comp.	2,000
General de Asfaltos	Wilde (B.A.)	500	SL	—
La Isaura	Bahia Blanca	2,200	SC	1,000
Loterro y Papini	Avellaneda (B.A.)	300	SL	—
Ragor (Ramon Gorleri)	Quilmes (B.A.)	30	SL	—
Ultramar (Socony-Texas)	Dock Sud-Avellaneda (B.A.)	6,000	Comp.	2,600
Y.P.F.[1]	Puerto La Plata	50,000	Comp.	23,000
	San Lorenzo (Santa Fe)	10,100	SC	6,200
	Lujan de Cuyo (Mendoza)	4,000	SC	3,000
	Chachapoyas (Salta)	1,900	SC	950
	Plaza Huincul (Neuquen)	1,600	SC	570

[1] YPF is building two topping plants with combined capacity of 18,000 B/D.

Australia:				
Bitumen Oil & Refineries Ltd.	Sydney	3,000	A	—
Commonwealth Oil Refineries Ltd.	Laverton, Victoria	2,900	S	—
Shell Co. of Australia	Clyde, N.S.W.	8,800	Comp.[1]	1,200
Vacuum Oil Pty. Ltd. (Standard-Vacuum)	Paisley	1,200	SLA	—

[1] 300 B/D acid clay lube plant under construction; to be completed in 1950.

Austria:				
Anglo-American Group				
Vacuum Oil Co.	Kagran	1,940	S	—
AG der Shell-Floridsdorfer Mineralolfabrik	Floridsdorf	2,500	SLA	—
Oesterr. Mineralolwerke	Lobau	4,850	S	—
Former German Group				
Benzin-Benzol-Verband	Vosendorf	1,165	S	—
Deutsche Erdol A.G.	Schwechat	3,100	SC	3,840
	Ebensee	1,860	S	—
Deutsche Gasolin A.G.	Korneuburg	700	S	—
Donau Oel G.M.B.H.	Moosbierbaum	2,330	S	—
German Gov't	Hauskirchen	1,540	S	—
Bahrein Island:				
Bahrein Petroleum Co.	Persian Gulf	145,000	SCA	25,000
Belgium:				
"Albatros" S.A. Belge pour le Raffinage de Petrole	River Scheldt	2,450	SC	1,000
Belgian Shell	Langerbrugge[1]	2,300	SLA	—
Compagnie Industrielle "Atlas" S.A.	Hoboken-Antwerp	2,000	S	—
Industrielle Belge des Petroles S.A.	Antwerp[2]	30,000	SC	?
Raffinerie Belge de Petroles	Antwerp[3]	2,200	SC	1,000
Raffineries et Distilleries Anversoises S.A. "Radian"	Antwerp, Kiel	740	S	—
Tankage et Transport S.A.	Antwerp, Kiel	1,000	S	—

[1] Operates on topped crude.
[2] Building, will be complete in 1951-52.
[3] 2,000 B/D distillation unit under construction; cracking unit being moved from California; additional distillation unit planned to increase capacity to 7,000 B/D in 1950.

Name of Company	Plant Location	Crude Capacity	Type Plant	Cracking Capacity
Bolivia:				
Yacimientas Petroliferous Fiscales Bolivianos	Camiri	1,575	S	—
	Cochabamba	5,000[1]	S	—
	Sandita	400	S	—
	Sucre	4,000[2]	S	—

[1] 5,000 B/D topping & reforming plant now under construction for completion January, 1951.
[2] 3,000 B/D topping plant included in capacity shown, scheduled for completion late fall, 1949.

British Borneo:				
Sarawak Oilfields Ltd.	Lutong, Sarawak	36,000	S	—

A new refinery to replace Lutong plant will be built on Muara Island in Brunei Bay with capacity of 36,000 B/D.

Burma:				
Burma Oil Co.	Rangoon	1,000	S	—
Nathsingh Oil Co. Ltd.	Yenangyaung	500	S	—
Brazil:				
Consuelho Nacional do Petroleo[1]	Bahia	500	S	—
	Bahia State	2,500[2]	Comp.	—
Destilaria Rio Grandense de Petroleo S.A.	Rio Grande	1,800	S	—
Industrias Matarazzo de Energia	Sao Paulo[3]	1,000	S	—
Ipiranga S.A. Cia. Brazilena de Petroleos	Rio Grande	1,800	S	—
Refinaria e Exploracao de Petroleo Uniao	Sao Paulo[4]	20,000	S	—
Refinaria de Petroleos do Distrita Federal	Rio[5]	10,000	—	—

[1] Also plan to buy 45,000 B/D combination unit in France to be erected at Belem, Para.
[2] Under construction, to be completed 1950; combination topping & thermal cracking.
[3] 100 B/D lube-wax unit to be completed in Sept., 1949.
[4] Plant to be bought in Czechoslovakia.
[5] Planned, construction not yet begun.

China:				
Chinese Petroleum Corp.	Hulutao, Manchuria[1]	2,000	S	—
	Kaoshiung, Taiwan, For.	10,000	SC	4,500
	Yumen	2,000	SC	600
Manchurian Petroleum Co.	Dairen[2]	5,000	SC	2,000

[1] Formerly an alcohol plant, reported rebuilt to run oil.
[2] Capacity shown is prewar; present unknown.

Chile:				
Johannsen, C. H.	Coquimbo	125	S	—
Maritano, Miguel	Talcahuano	60	S	—
Societe Establecimientes Quimicos	Vina del Mar	175	S	—
Corp. de Fomento	Santiago[1]	10,000	SC	—

[1] Planned for completion in 1952.

Colombia:				
Colombia Petroleum Co.	Petrolea	900	S	—
Tropical Oil Co.	Barranca Bermeja	22,600	SLA	—
Cuba:				
Cia. Exploradora de Petroleo	Jarahuoca	365	S	—
Standard Oil Co. of Cuba	Belot	5,000	SCLA	1,100
Cia. Petrolera Jarahuoca	Jarahuoca	320	S	—
Cuban Oil Ref. Co.	Cabaiguan	110	S	—
Union Gas Co.	Bacaranao	285	S	—

Name of Company	Plant Location	Crude Capacity	Type Plant	Cracking Capacity
Canada:				
Anglo-Canadian Oils, Ltd.	Brandon, Manitoba	2,300	SC	1,100
British American Oil Co., Ltd.	Montreal, East [1]	15,500	SCA	7,500
	Toronto, Ontario	5,000	S	—
	Clarkson, Ontario	10,000	Comp.	4,400
	Moose Jaw, Saskatchewan	5,000	SCA	2,000
	Calgary, Alberta	5,500	SCA	2,500
Canadian Oil Companies, Ltd.	Petrolia, Ontario	7,000	SC	2,150
Excelsior Refineries, Ltd.	Lloydminster [2]	1,500	SA	—
Husky Oil & Ref. Co.	Lloydminster	7,500	SA	—
Gas & Oil Refineries, Ltd.	Hartell, Alberta	2,000	SC	1,000
Gold Standard Oils, Ltd.	Wainwright, Alberta	300	S	—
Hi-Way Refineries, Ltd.	Moose Jaw, Sask.	400	S	—
	Saskatoon, Sask.[2]	400	S	—
	Rosetown	400	S	—
Imperial Oil, Limited	Dartmouth, Nova Scotia	22,000	SC	9,900
	Montreal, East	37,000	SC	17,600
	Sarnia, Ontario	53,000	Comp.	23,000
	Regina, Sask.	15,000	SCA	9,000
	Calgary, Alberta	10,000	SCA	4,000
	Ioco, Br. Col.	12,000	SC	2,750
	Norman Wells, NW. Ter.	1,100	S	—
	Edmonton, Alberta [4]	6,000	SC	4,000
McColl-Frontenac Oil Co., Ltd.	Montreal, East	31,000	SC	14,000
	Toronto, Ontario	12,000	SC	7,000
New Brunswick Oilfields, Ltd.	Weldon, New Br.	300	S	—
North Star Oil, Ltd.	Winnipeg, Manitoba	2,000	SC	680
Northern Petroleum Corp., Ltd.	Kamsack, Sask.	600	S	—
Radio Oil Refineries, Ltd.	East Kildonan, Manitoba	1,500	S	—
Saskatchewan Federated Cooperatives, Ltd.	Regina, Sask.	2,000	SC	1,000
Shell Oil Co. of Canada, Ltd.	Montreal, East [5]	14,000	SC	7,000
Shell Oil Company of British Columbia, Ltd.	Shellburn, Br. Col.	7,000	SC	3,000
Standard Oil Co. of British Columbia, Ltd.	Burnaby, Br. Col.	8,350	S	—
Trinidad Leaseholds	Port Credit	5,500	Comp.	3,000

[1] Plant now being expanded to crude capacity of 32,070 B/D; 13,359 B/D fresh feed to Kellogg fluid catalytic cracker; 7,500 B/D fresh feed to Winkler-Koch thermal cracker; 700 B/D poly gasoline unit. New facilities planned for completion fall, 1949.

[2] 3,000 B/D cracking unit under construction; estimated completion Sept., 1949.

[3] 2,000 B/D topping unit and 600 B/D Dubbs cracking unit to be completed Dec. 1, 1949.

[4] 7,000 B/D additional crude distillation to be completed early summer, 1949.

[5] Topping capacity being increased to 25,000 B/SD; vacuum flashing to 11,000 B/SD; fluid cat cracking to 10,000 B/SD. Gas recovery, treating, polymerization & other auxiliaries being installed.

Eire:				
Cork Harbour Oil Wharves Ltd.	Haulbowline Is., Co. Cork	600	S	—
France:				
Cie. Francaise de Raffinage	Normandy [1]	45,200	Comp.	3,000
	Provence	37,000	SC	6,750
Cie. de Raffinage Shell-Berre	Petit Couronne	35,000	Comp.	2,000
	Pauillac	4,700	SA	—
	Berre	21,600	Comp.	5,200
Pechelbronn S.A.E.M.	Merkwiller	1,000	Comp.	—
Raffineries Francaise de Petrole de L'Atlantique	Donges [2]	15,000	Comp.	2,500
Raffineries de Petroles de la Gironde	Bec d'Ambes [3]	—	—	—
Societe Generale des Huiles de Petrole	L'Avera [4]	35,000	Comp.	4,000
	Dunquerque [5]	—	Comp.	—
Socony-Vacuum Francaise	N.D. de Gravenchon	8,000	Comp.	—
	Frontignan	20,000	Comp.	—
Standard Francaise des Petroles	Port Jerome [6]	40,000	Comp.	6,300
	La Mailleraya	500	S	—

[1] Lube plant planned.

[2] Plant equipped for thermal reforming at 3,000 B/D.

[3] Plant destroyed during war; will be rebuilt to 13,000 B/D by Nov., 1949.

[4] Cross cracking plant being reconstructed.

[5] Plant being rebuilt; will have crude capacity of 7,500 B/D by Jan. 1, 1950, and 26,000 B/D in 1951. Additional construction includes 6,800 B/D thermal reforming and 1,100 B/D lube plant.

[6] Lube processing equipment now being installed.

Summary of Refinery Capacities

Operating or Operable Capacities, July 1, 1949

Country	No. Plants	Crude Capacity Barrels Daily	Cracking Capacity Barrels Daily
Argentina	18	122,530	59,620
Australia	4	15,900	1,200
Austria	9	19,980	3,840
Bahrein Island	1	145,000	25,000
Belgium	7	10,690	2,000
Bolivia	3	2,975	—
Brazil	4	4,800	—
British Borneo	1	36,000	—
Burma	2	1,500	—
Canada	33	303,050	91,530
Chile	3	360	—
China	4	19,000	7,100
Colombia	2	23,500	—
Cuba	5	6,080	1,100
Denmark	3	660	—
Ecuador	2	4,700	—
Egypt	2	41,000	7,000
Eire	1	600	—
France	14	263,000	29,750
Germany	22	64,950	5,820
Hungary	8	23,425	—
India	1	5,500	—
Iran	3	572,100	125,000
Iraq	2	9,500	—
Italy	8	60,200	14,500
Japan	14	32,120	—
Mexico	9	168,090	24,650
Netherlands	1	60,000	16,500
Netherlands East Indies	6	160,000	40,700
Netherlands West Indies	3	627,000	403,000
Pakistan	1	4,000	2,000
Palestine	1	83,000	33,000
Peru	3	34,500	6,000
Poland	6	14,550	—
Portugal	1	7,000	—
Romania	20	132,750	37,850
Saudi Arabia	1	140,000	20,000
Spain	2	14,600	5,000
Sweden	3	23,700	2,300
Switzerland	2	1,850	—
Syria	1	5,500	—
Trieste	2	17,500	—
Trinidad	5	101,300	35,000
United Kingdom	21	155,980	17,500
United States	390	6,340,000	1,800,000
U.S.S.R.*	25	675,000	250,000
Uruguay	1	17,000	1,900
Venezuela	13	191,920	24,000
Yugoslavia	5	8,300	—
TOTAL	698	10,772,660	3,092,860
WESTERN HEMISPHERE	494	7,948,805	2,387,800
EASTERN HEMISPHERE	204	2,824,855	705,060

* Estimated.

Name of Company	Plant Location	Crude Capacity	Type Plant	Cracking Capacity
Egypt:				
Anglo Egyptian Oil Fields Ltd.	Suez	36,000	SCA	7,000
Refinnerie de Petrole du Government	Suez	5,000	SA	—
Denmark:				
AA/S Kalundborg Olieraffinaderi	Kalundborg	530	A	—
Dansk Mineroloiiefabrik	Copenhagen	65	S	—
L. C. Glad & Co.	Copenhagen	65	S	—
Ecuador:				
Anglo Ecuadorian Oilfields Ltd.	La Libertad	4,000	SL	—
Ecuador Oilfields Ltd.	Cautivo	700	S	—
Germany: American Zone:				
Deutsche Vacuum Oil A.G.	Bremen-Oslebshausen	12,500	SL	—
Deutsche Shell A.G.	Monheim [1]	2,000	SLA	—
Zeller & Gmelin	Eislinger-Wuertemberg	150	—	—

[1] Topping and vacuum installation under construction will increase capacity to 4,000 B/D by Jan., 1950.

Name of Company	Plant Location	Crude Capacity	Type Plant	Cracking Capacity
Germany: British Zone:				
Deurag-Nerag Gewerkschaft	Misburg n. Hanover [1]	8,500	Comp.	2,600
Deutsche-Amerikanische Petroleum Gesellschaft (SONJ) Ebano Asphalt-Werke	Hamburg-Harburg	13,000	SLA	—
Deutsche Erdoel A.G.	Heide	2,400	S	—
	Wietze	1,200	Comp.	—
Deutsche Gasolin A.G.	Dollbergen [2]	2,250	Comp.	—
Deutsche Shell A.G.	Hamburg-Harburg [3]	—	LA	—
	Reisholz	1,200	S	—
	Hamburg-Grasbrook	1,300	L	—
	Hamburg-Wilhelmsburg	680	S	—
Deutsche Vacuum Oel A.G.	Schlau-Hamburg [4]	700	Comp.	—
Europaische Tanklager und Transport A.G.	Hamburg-Finkenwarder [5]	8,400	SC	2,800
Greiser	Dollbergen	300	S	—
Johann Haltermann	Wilhelmsburg	2,000	S	—
Mineraloel & Asphaltwerke	Ostermoor	2,400	SA	—
Mineraloelwerke Peine	Peine n. Hanover	600	SL	—
Oelwerke Julius Schindler	Hamburg	720	Comp.	—
Ernst Schliemann's Oelwerke	Hamburg-Grasbrook [6]	800	L	—
Wintershall A.G.	Salzbergen	1,200	Comp.	420

[1] Solvent wax de-oiling plant & TEL blanding plant completed 1949; Unisol plant, 1950.
[2] Dewaxing unit under construction.
[3] Capacity by end of 1949 to be 10,400 B/D.
[4] Shut down.
[5] Cracking plant being rebuilt.
[6] Dewaxing plant under construction, will be completed in 1949. Solvent refining plant will be completed in 1950.
Note: Deutsche Erdoel and Wintershall A.G. are proposing the erection of new 7,500 B/D plants. Neither has been approved as yet.

Germany: French Zone:				
Badische Anilin & Soda Fabrik	Ludwigschafen	650	SL	—
Germany: Russian Zone:				
Wintershall A.G. Also hydrogenation and Fischer-Tropsch plants.	Luetzkendorf, nr. Leipzig	2,000	Comp.	—
Hungary:				
Molaj Magyar Szovjet Olajmuvek R.T.	Szony	7,600	S	—
Vacuum Oil Co. R.T.	Almasfuzito	4,600	Comp.	—
Magyar Petroleumipar R.T.	Budapest	760	Comp.	—
Peti Nitrogenmuvek R.T.	Petfurdo	4,900	Comp.	—
Shell Koolaj R.T.	Csepel	3,500	Comp.	—
Fanto Egyesult Magyar Asvanyolajgyrak R.T.	Gyovar Budapest	365	Comp.	—
Nyirbogdanyi Petroleumgyar R.T.	Nyirbogdanyi	1,400	Comp.	—
Szoregi Petroleumgyar R.T.	Szoregi	300	Comp.	—
India:				
Assam Oil Co.	Digboi	5,500	S	—
Iran:				
Anglo-Iranian Oil Co.	Abadan [1]	500,000	SCA	125,000
	Kerminshah	2,100	S	—
	MIS [2]	70,000	T	—

[1] Catalytic cracking unit of 30,000 B/D and lube plant of 400 B/D under construction.
[2] Crude topping plant for Abadan refinery; makes no finished products, ships tops or bottoms to Adaban by P.L. as required for finishing.

Iraq:				
Iraq Petroleum Co.	Baba Gurgur	1,500	S	—
Kanaquin Oil Co., Ltd. (Anglo-Iranian)	Alwand	8,000	S	—
Government of Iraq plans to build a 1,000 B/D plant at Baiji.				
Italy:				
A.N.I.C.	Leghorn	4,500	SC	4,000
	Bari	16,000	SC	3,500
Azienda Generale Italiana Petroli (AGIP)	Savona	400	S	—
	Venice	11,000	SC	2,000
Distillazione Italiana Combustibili S.A. (DISCA)	Marghera (Venice)	5,000	SC	3,500
Lombarda Petroli	Villa Santa [1]	1,200	S	—
Permolio	Milan [1]	1,300	S	—
	Genoa [1]	1,350	S	—
	Fiorenzuola [1]	1,000	S	—
	Rome [1]	1,000	S	—
Petroli d'Italia	Fiorenzuola [1]	250	S	—
Raffineria di Napoli SAI (Socony-Vacuum)	Naples	16,000	S	—
Raffineria Siciliane Olii Minerali (RASIOM)	Augusta, Sicily [2]	10,000	—	—
SIROM	Cologne, Monzes [1]	600	S	—
Societa per la Industria Italiana del Petrolio (Nafta)	La Spezia [2]	7,500	SC	1,500
Societa Petrolifera Italiana	Fornovo Taro, Parma	300	S	—

[1] Proposed if approved by ECA.
[2] Being moved from Longview, Texas, U.S.A.
[3] Includes 1,000 B/D topped crude capacity. Shell has been authorized to build a 40,000 B/D plant at Apuania, north of La Spezia.
Note: S. A. Raffineria Padana Olii Minerali (Fiat-Caltex) will build a 40,000 B/D plant at Trecate. Completion scheduled in 1952.
CONDOR S.p.a. per l'Industria Petrolifera e Chimica has acquired a 300-acre site near Milan for the construction of a 20,000-B/D refinery.

Japan:				
Daikyo Oil Co.	Yokaichi	1,550	S	—
Koa Oil Co.	Marifu	5,000	S	—
	Yokohama	500	S	—
Maruzen Oil Co.	Shimotsu	2,000	S	—
Nippon Kohyo Co.	Funkawa	3,000	S	—
Nippon Oil Company	Akita	4,775	SLA	—
	Hokkaido	252	S	—
	Kashiwazaki	1,575	SLA	—
	Niigata	2,500	LA	—
	Yokohama City [1]	—	—	—
	Yamaguchi Prefecture [1]	—	—	—
Showa Oil Co.	Kawasaki	5,800	S	—
	Kainau	280	S	—
	Harisawa	500	S	—
	Niigata	3,000	S	—
Toa Co.	Shimizu	1,400	S	—

[1] Forced to stop operations by direction of GHQ, Sept. 27, 1946.
Note: Standard-Vacuum and Caltex each plan installation of 10,000 B/D refineries, if permitted to do so.

Korea:				
Russian Government	Genzan (Wansun)	5,000	S	—
Mexico:				
Pemex—Arbol Grande	Tampico	19,000	SLA	—
" —Cuidad Madero	Tampico	63,000	Comp.	6,050
" —18 de Marzo	Atzcapotzalco, D.F.	47,000	SC	13,000
" —Mata Redonda	Tampico [1]	8,700	SC	5,600
" —Minatitlan	Minatitlan	23,000	SL	—
" —Poza Rica	Poza Rica [2]	5,900	S	—
"	Nuevo Laredo	330	S	—
"	Monterey	160	S	—
"	Juarez	1,000	S	—
"	Salamanca [3]	25,000	SC	4,000

[1] Crude unit being enlarged to 15,000 B/D.
[2] 150 tons per day sulfur production plant under construction in connection with 100 mmcf gas drying and desulfurization plant.
[3] Under construction; crude unit to be completed Dec., 1949; cracking unit Oct., 1950.

Netherlands:				
N.V. Bataafsche Petroleum Mij. (Shell)	Rotterdam [1]	60,000	Comp.	16,500
Caltex Petroleum Mij. N.V.	Pernis, Rotterdam [2]	20,000	Comp.	6,400

[1] To be increased to 75,000 B/D within five years. Current crude capacity shown includes crude charged direct to cracking plant. Normal crude distillation capacity is 7,000 B/D.
[2] Building; expected completion early 1950.

Netherlands West Indies:				
Arend Petroleum Mij.	Aruba	27,000	SC	3,000
Curacaosche Petroleum Industrie Mij.	Curacao	200,000	SC	100,000
Lago Oil & Transport Co.	Aruba	400,000	SCA	300,000

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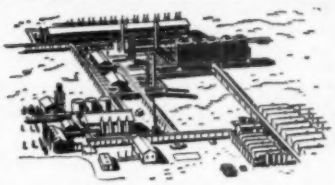
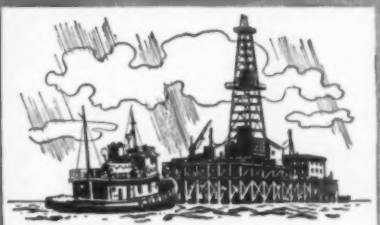


● Shell Oil Company's TXL Gasoline Plant near Odessa, Texas. This is a prime example of Brown & Root's flexibility in meeting the demands of a client's changing conditions. The original contract called for a 30,000 mcf gasoline plant. During plant construction the mcf was revised to 45,000. Shortly after completion, the throughput demands were raised to 90,000 mcf . . . triple the original requirements! Farsighted planning by Brown & Root engineers allowed continuous plant operation while this tremendous project was effected.



● Offshore drilling. Derrick foundation constructed by Brown & Root Marine Operators, Inc., for a drilling operation far out in the Gulf of Mexico. "Brown-Bilt" in six fathoms of open water, its crown block towers 237 feet above the floor of the turbulent Gulf. It must withstand not only storms of hurricane strength but also the rigors of heavyweight rotary drilling operation.

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Name of Company	Plant Location	Capacity Crude	Plant Type	Capacity Cracking
Netherlands East Indies:				
N.V. de Bataafsche Petroleum Mij. (Shell)	Balikpapan, N.E. Borneo	8,500	S	—
	Pangkalan Brandan, Sumatra [1]	23,000	—	—
	Pladjoé, Sumatra	45,000	SC	7,700
	Tjepoe, Java [1]	15,000	SC	3,000
	Wonokromo, Java	1,500	SA	—
N.V. Standard Vacuum Petroleum Mij.	Palembang, Sumatra	67,000	Comp.	30,000

[1] Shut down, plant condition unknown.

Pakistan:				
Attock Oil Co.	Punjab, Rawahlpindi	4,000	SC	2,000
Palestine:				
Consolidated Refineries Ltd.	Haifa [1]	83,000	SCA	33,000

[1] Shut down because of political disurbances.

Peru:				
Cia. de Petroleo Ganzo Azul	Aguas Calientes	500	S	—
Establecimiento Ind. de Pet. de Zorritos	Zorritos	1,000	S	—
International Petroleum Co.	Talara	33,000	Comp.	6,000

Poland:

All Refineries Under "Central Management of the Liquid Fuel Industry," "United Petroleum and Natural Gas Industries" Branch:

Czechowice Refinery	4,000 crude	Comp.	—
Trzebina Refinery	6,500 "	SL	—
Jaslo Refinery	1,200 "	SL	—
Glinik Refinery	1,500 "	Comp.	—
Jedlicze Refinery	1,100 "	SL	—
Ligora Refinery	250 "	SL	—

Portugal:				
"Sacoy" S.A. Concessionaria da Rafinaco de Petroles em Portugal	Lisbon	7,000	SL	—

Romania:

Refining properties of American and European oil companies have been taken over by the government, and little is currently known about the extent to which war damage has been repaired.

"Astra Romana" S. A.	Ploesti-Sud	25,000	Comp.	12,000
"Colombia" Societe Franco Roumaine de Petrole	Ploesti-Sud	10,000	Comp.	4,800
Concordia Vega S. A. Roumaine pour l'Industria du Petrole	Ploesti-Nord	20,000	Comp.	4,200
"Creditul Miniere" S.A.R. Pentru Desvoltarea Industriei Miniere	Brabi-Prahova	5,500	Comp.	2,400
Dacia Romana Petroleum Syndicate, Ltd.	Ploesti [1]	2,700	S	—
Neo Petrole Fratia	Ploesti-Sud	3,200	S	—
Noris	Ploesti-Sud	1,300	S	—
"Petrole Block" S.A. Romana	Ploesti (Standard)	7,000	Comp.	3,450
"	Buzau (Saturn)	500	S	—
Petrol Latina SAR	Ploesti	3,000	S	—
"Photogen" Rafinerie de Petrol S.A. (Soc.-Vac.)	Brasov	3,500	SL	—
"Prahova" S.A. Romana (Petrol Bucuresti)	Bucarest [1]	3,500	Comp.	—
Rafinaria de Petrol "Titan"	Bucarest-Cioplea [1]	900	S	—
Romano-Americana S. A. pour l'Industrie, le Commerce et l'Exportation du Petrole	Teleajen (nr. Ploesti)	18,000	Comp.	8,000
Romano-Belgiana de Petrol "Venus"	Sarat	900	S	—
Soc. Generala M & P	Doicesti-Dambovita	1,500	S	—
"Steaua Romana" S. A. pour l'Industrie de Petrole	Moinesti	1,050	S	—
"	Campina	12,000	Comp.	—
"Unirea" S. A. Romana de Petrole	Ploesti (2 plants) [1]	8,600	Comp.	—
"Xenia" S. A. (Sov-Ro-M Petrol)	Ploesti-Nord	4,600	S	3,000

[1] Ordered shut down in accordance with government program of integration of operations.

Name of Company	Plant Location	Crude Capacity	Type Plant	Cracking Capacity
Saudi Arabia:				
Arabian American Oil Co.	Ras Tanura [1]	140,000	S	—

[1] Reforming capacity 20,000 B/D.

Spain:				
"Campsa" Cia. Arrandatarin del Monopolio de Petroleo, S.A.	Barcelona	600	SL	—
"Cepsa" Cia. Espanola de Petroleo S.A.	Canary Is.	14,000	SC	5,000

Sweden:				
Johnson & Co., A.	Nynashamm	10,000	Comp.	2,300
	Malma	1,700	A	—
Stora Kopperberg Inc-Transatlantic	Goteborg [1]	12,000	SC	—

[1] Operations to begin in July, 1949; capacity being increased to 24,000 B/D topping & reforming.

Switzerland:				
Ispa A.G.	Rotkreuz [1]	1,500	S	—
Schweiz-Sprengstoff Fabrik	Dottikon [2]	350	—	—

[1] Operates on tops.
[2] Manufactures special naphthas.

SYRIA				
Iraq Petroleum Co.	Tripoli [1]	5,500	S	—

[1] To be increased to 10,000 B/D in 1949.

Trieste:				
Aquilla (Redeventza)	Trieste [1]	15,000	SL	—
Soc. Italo Americano Petrado (SIAP)	Trieste	2,500	SLA	—

[1] Lube plant is being rebuilt and reforming unit installed.

Trinidad:				
Kern Trinidad Oilfields	Trinidad	1,000	S	—
Trinidad Lake Asphalt Operating Co.	Brighton	1,000	A	—
Trinidad Leaseholds Ltd.	Point-a-Pierre [1]	70,000	Comp.	35,000
Trinidad Oil Fields Operating Co. Ltd.	Port of Spain	1,300	S	—
United British Oilfields	Point Fortin	28,000	SA	—

[1] 25,000 B/D reduced crude thermal cracking; 10,000 B/D naphtha reforming; 15,000 B/D fluid catalytic cracking unit with vacuum feed preparation unit & visbreaker planned for early construction.

Uruguay:				
Administration Nacional de Combustibles, Alcohol y Portland (ANCAP)	Montevideo [1]	17,000	SC	1,900

[1] New 7,500 B/D topping unit & 750 B/D vacuum still being installed; to be completed 1949.

United Kingdom:				
Anglo-American Oil Co.	Fawley [1]	18,000	SCA	7,000
Berry, Wiggins & Co., Ltd. (2 Plants)	Kingsnorth, Kent	1,500	SL	—
"	Weaste (nr. Manchester)	1,200	S	—
Briggs & Son, Ltd., William	Dundee	700	SL	—
Carless, Capel & Leonard	London	200	S	—
Cory Bros. & Co., Ltd.	Corydon	3,000	SC	2,000
Green, Herbert & Co.	E. Halton, Lincolnshire	1,500	SL	—
Keys, W. H., Ltd.	Avonmouth	450	S	—
"	West Bromwich	350	S	—
Lobitos Oil Fields, Ltd.	Ellesmere Port	3,000	SC	1,000
London & Coastal Oil Wharves, Ltd.	Canvey Island	1,500	S	—
London & Thames Haven Oil Wharves, Ltd.	Thames Haven [2]	6,500	SA	—
Major & Co., Ltd.	Hull	880	SL	—
Manchester Oil Refinery, Ltd.	Manchester [1]	3,000	SL	—

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Name of Company	Plant Location	Crude Capacity	Type Plant	Cracking Capacity
National Oil Refineries, Ltd.	Llandarcy, So. Wales [1]	20,600	Comp.	4,000
Scottish Oils, Ltd.	Grangemouth, Scotland [2]	14,000	SC	3,000
	Uphall (Pumpherston)	2,000	SC	500
Shell Refineries, Ltd.	Androssan, Ayrshire	4,300	A	—
	Shell Haven, London	16,600	Comp.	—
	Stanlow (Ellesmere Port) [3]	16,700	Comp.	—
	Trimpel, Heysham	30,000	S	—

[1] To be expanded to 120,000 B/D.

[2] Plant consists of 6,500 B/D topping; 2,000 B/D benzene refinery; 2,400 B/D vacuum distillation (bitumen); and 450 B/D asphalt oxidation plant.

[3] Lube treating capacity being increased & storage enlarged.

[4] Crude distillation unit under construction will enlarge capacity to 62,000 B/D by end of 1949. Additional 9,000 B/D reformer & also lube plant to bring capacity to 1,800 B/D planned.

[5] Crude distillation unit under construction will bring capacity to 35,000 B/D; 10,000 B/D cat cracker planned.

[6] Producing 35,000 tons per year of detergents.

Note: Work is expected to begin this year on 56,000 B/D refinery of Anglo-Iranian Oil Co. and Gulf Oil Corp. on the Isle of Grain.

U.S.S.R.:

Before the war there were 13 refineries in Soviet Russia with a crude capacity of 637,500 barrels daily and a cracking capacity of 178,500 barrels daily. The Government has not announced a list since the war.

Name of Company	Plant Location	Crude Capacity	Type Plant	Cracking Capacity
Venezuela:				
British Controlled Oilfields	El Mene	250	S	—
Creole Petroleum Co.	La Salina	10,000	SA	—
	Amuay Bay [1]	60,000	SCLA	—
	Caripito	55,000	SC	24,000
Mene Grande Oil Co.	Cabimas	1,800	S	—
	Cabimas [2]	10,000	S	—
	Oficina	420	S	—
Shell Caribbean	San Lorenzo	41,000	S	—
Shell Co. of Venezuela, Ltd.	Casigua	1,500	S	—
	La Rivera	200	S	—
	El Cavario	200	S	—
	Punta Cardon	60,000	SC	—
Sinclair Oil & Refining Co.	Puerto La Cruz [3]	35,000	S	—
Texas Petroleum Co.	Tucupita	11,000	S	—
Tocuyo Oilfields of Venezuela Ltd.	El Mene [4]	250	S	—
Venezuela Gulf Refining Co.	Puerto La Cruz [3]	30,000	S	—

[1] Building; will be completed Jan., 1950.

[2] Heavy crude processing plant, manufactures fuel oil.

[3] Under construction; to be completed late in 1950.

[4] Shut down.

Refinery Expansion in U. S. A.

(Continued from page 67)

increase its output of anhydrous ammonia and to include units for the production of sulfuric acid and ammonium sulfate. The last of these additions will reach competion by the end of the year.

The Texas Company is completing additions to its West Tulsa, Oklahoma, refinery, which include a crude pipe still of 30,000 barrels per day capacity, a catalytic polymerization unit, an acid treating and sweetening plant, additional steam generating and cooling water facilities and other auxiliary construction.

At Ponca City, Oklahoma, Continental Oil Company is carrying out a large program of expansion which will add 19,000 barrels to its daily charging capacity. At the same place Cities Service Company is preparing the modernization of its refinery by installation of a vacuum unit, a catalytic cracker, fractionation and gas recovery facilities, a catalytic polymerization unit and needed accessories.

Texas and Louisiana, with more refineries than any other area, including some of the largest plants in the country, always are the scenes of much construction activity, and this has been the case during the past year. At Baton Rouge, Louisiana, Esso Standard Oil Company is in the midst of one of the largest of current construction programs. It includes a huge crude distillation unit of 58,000 barrels daily charging capacity, two vacuum distillation units, one to supply lube cuts and fuel oil and the other to produce gas oil as feed for the cat cracker. Other installations are compression, absorption and distillation units, a polymer plant, MEK dewaxing unit and numerous auxiliary installations. With these additions the daily charge capacity of the plant will be close to 250,000 barrels, making it probably the largest refinery in the country.

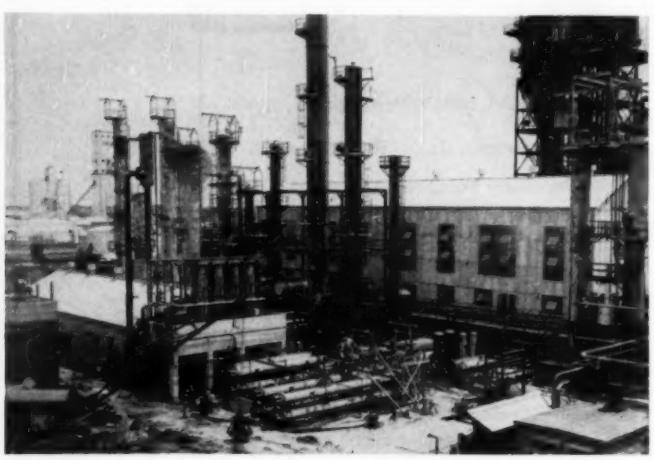
Another plant located on the Mississippi River is the Norco refinery of Shell Oil Company, which has had its daily charging capacity increased to 45,000 barrels by installation of a pressure distillate fractionating tower which releases thermal topping facilities formerly employed in processing cracked distillate.

Further westward at Lake Charles, Louisiana, the world's largest lubricating oil plant is approaching completion. It is being built by the Cit-Con Company, jointly owned by Cities Service Company and Continental Oil Company, at a cost reported to be approximately $40 million. In operation it will have a daily output of 6,000 barrels of lubricating oil including a large proportion of premium quality oil. Feed stock of 18,000 barrels daily will be delivered from the nearby refinery of Cities Service Company, and after extraction of the desired cuts, the residue will be returned to the Cities Service plant for further processing. Two vacuum distillation units, each with a charging capacity of 12,500 barrels, will fractionate reduced crude into cuts for solvent refining, which will be performed in the largest furfural unit ever constructed, capable of circulating 30,000 barrels of solvent per day and of processing 71,000 barrels.

Solvent refining of the vacuum tower residuum will be done by the Duo-Sol process in the largest plant of its kind. It will have a charging capacity of 9,700 barrels per day, and its extractor section will have seven extractors, each 90 feet in length and with diameters up to 10 feet. Dewaxing of refinnate stocks will be by the MEK process. Clay treatment will be employed to improve color and stability and will be followed by percolation through bauxite clay. Wax production of the plant will be roundly 35,000 tons annually. Construction of the plant is in charge of The Lummus Company, except the Duo-Sol unit which is being built by Max B. Miller Co.

Port Arthur, Texas, maintains its position as one of the country's great refining centers by additions to its large plants. The Texas Company has expanded the lubricating oil and wax manufacturing facilities at its plant. The installations include an atmospheric crude topping and vacuum pipe still, a solvent dewaxing unit, a furfural refining plant and auxiliaries. The additions will increase the output of finished lubricants by about 2,500 barrels per day. Construction is being handled by Foster-Wheeler Corporation. Gulf Refining Co. has installed at its Port Arthur plant three of the latest type crude distillation units, each with a daily capacity of 20,000 barrels, and a 32,000-barrel polyform refining unit to add to capacity and improve the octane rating of the gasoline.

Shell Oil Company has completed at its refinery near



M-E-K unit at the Coffeyville, Kansas, refinery of the Co-operative Refinery Association. Photograph was taken during course of construction, looking across refrigeration area to fractionating towers and filter building.

New 35,000,000 cu. ft. natural gas processing plant of H. L. Hunt in the Harleton Field near Marshall, Texas.

New 50,000,000 cu. ft. natural gas processing plant of the Hunt Oil Company in the N. E. Lisbon Field near Lisbon, Louisiana.

The two new plants shown above were engineered, designed and constructed simultaneously, and both contain equipment which we salvaged in the dismantling of the Hunt Oil Company's absorption plant in the Long Lake Field near Palestine, Texas.

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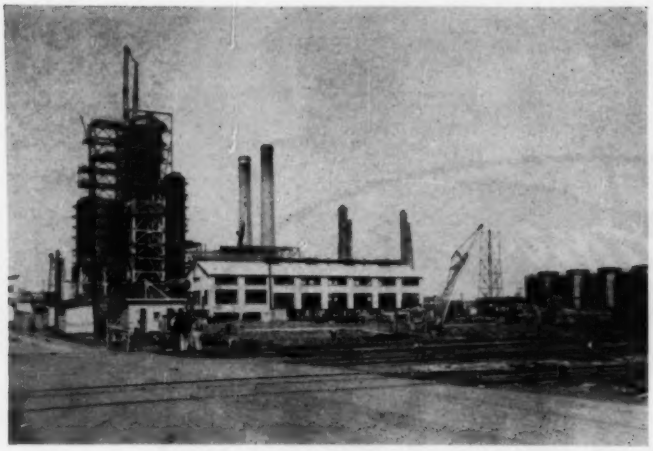
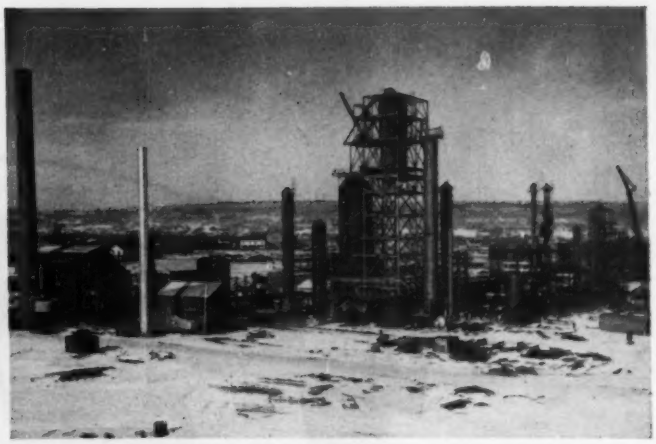


Cat cracker and compressor house at the Lima, Ohio, refinery of The Standard Oil Co. of Ohio.



Continental Oil Company's refinery at Billings, Mont., is one of the large new installations in the Rocky Mountain area.

Houston, Texas, one of the most complete lubricating oil plants in the country at a reported cost of $20 million. The plant has an output capacity of 2,800 barrels daily. It derives feed stocks from the neighboring Shell refinery and includes two vacuum distillation units, a propane deasphalting and phenol extraction plant, an MEK dewaxing plant and a contact clay filtration plant. Other additions to the Shell refinery are a large power plant, a maintenance shop and a research laboratory. With the neighboring plant of Shell Chemical Company, which was put into operation late in 1948 for the large-scale production of glycerine from petroleum, the Shell group of plants constitutes a highly important center of refining activity.

The Baytown, Texas, refinery of Humble Oil & Refining Company, already among the very largest in the country, received important additions in 1948 through the expenditure of $16 million for a pipe still of 45,000 barrels daily capacity, a phenol extraction plant and an MEK dewaxing unit completed early in the year. One of the projects undertaken during the present year was the construction of large centralized machine shops fully equippped for refinery repair and maintenance.

Pure Oil Company is pushing to completion extensive additions to its Smith's Bluff, Texas, refinery. Installations include a two-stage distillation unit with a capacity of 18,000 barrels daily, designed and erected by Foster Wheeler Corporation. A lubricating oil plant includes propane deasphalting, phenol extraction, MEK solvent dewaxing and contact finishing units. New steam generating and feed water treating facilities were installed to handle expanded operations. Boilers for the steam plant were supplied by Combustion Engineering Company, and the power plant along with other related equipment was installed by Stone & Webster's engineering department.

At its Beaumont, Texas, refinery Magnolia Petroleum Company has installed two vacuum distillation towers, designed by M. W. Kellogg Company, and lubricating oil equipment including a furfural plant and MEK dewaxing unit, constructed by The Lummus Company. A change planned for the coming year is the installation of two TCC units of 30,000 barrels combined daily capacity to replace Houdry fixed-bed catalytic cracking units introduced several years ago.

Rapid growth of the oil industry in the Rocky Mountain region has led to a substantial increase in refining activity. One of the noteworthy events of the year in that area will be the opening of the Billings, Montana, refinery of Continental Oil Company, which is expected to be ready for operation sometime during the final quarter of 1949. The plant is designed for a daily throughput of 7,500 barrels. In order to handle crudes of high sulfur content, it will have a desulfurizing unit. Otherwise the plant will be of conventional design with a crude topping unit, a fluid catalytic cracking unit, a rerun unit, a vapor recovery unit, catalytic polymerization unit and deasphalting unit. Design and construction of the plant is by the refining division of Jones & Laughlin Supply Co.

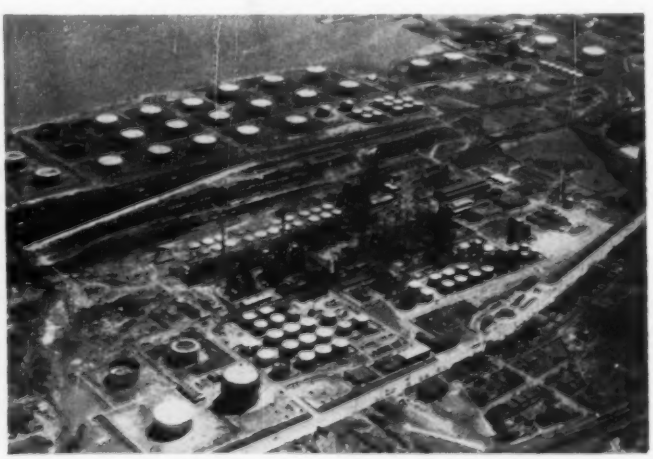
Another refinery of 30,000 barrels daily capacity is being built at Billings by Carter Oil Company. It will include atmospheric and vacuum pipe stills, fluid catalytic cracking unit and other customary processing equipment, and is to be completed about the end of the year.

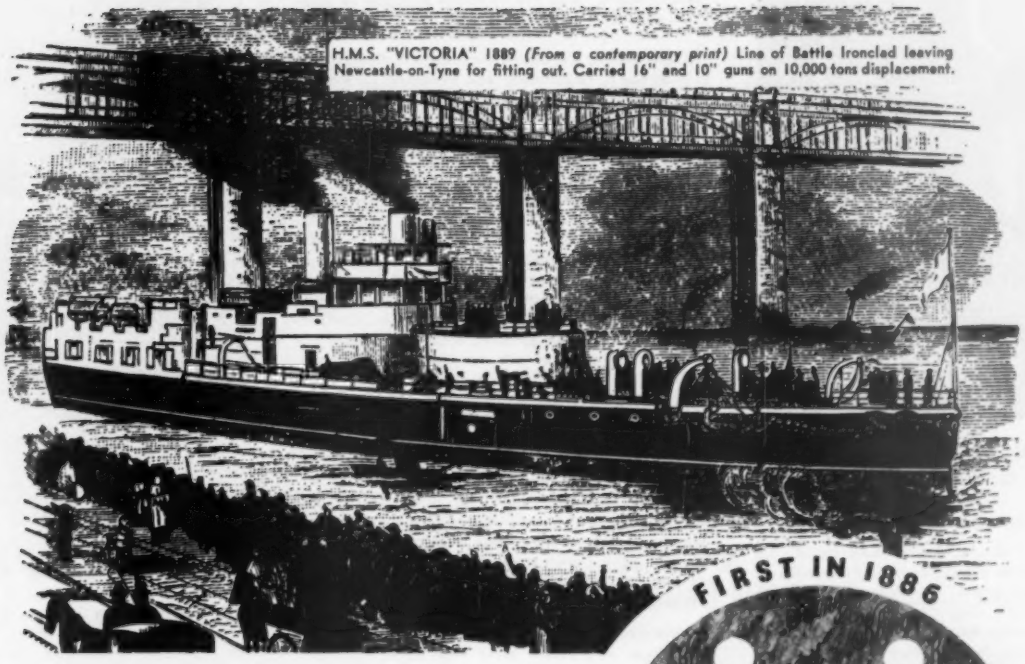
At Casper, Wyoming, Socony-Vacuum Oil Company is modernizing its refinery and increasing its daily capacity to 6,000 barrels. Additions include a crude distillation tower, TCC unit, a new power plant, pumping equipment and housing facilities for employees. Also at Casper, Standard Oil Company (Indiana) installed a fluid catalytic cracking unit in its refinery, thus practically completing for the present the broad program of modernization which it started in 1946 and which has included catalytic cracking installations in eight of its refineries. The company also installed early in 1949 a propane deasphalting unit in the refinery of Utah Oil Refining Company at Salt Lake City, Utah.

The plant of Salt Lake Refining Co. at Salt Lake City, Utah, which went on stream in November 1948, is undergoing a $10 million expansion which is scheduled for completion about the end of 1950. The company is a wholly owned subsidiary of Standard Oil Company of California, and the purpose of the owners is to develop it into a completely equipped plant for the production of high test gasoline, diesel oil, heat-

Standard Oil Co. of California has installed 29 mixers with an annual capacity of 38 million pounds at its new Richmond grease plant.

Aerial view of the Marcus Hook, Pennsylvania, refinery of Sinclair Refining Co. where major expansion work has been in progress.





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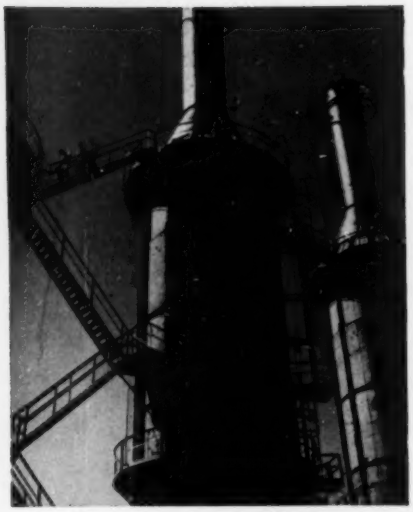


Duo-sol heaters at the Cit-Con Corp. lubricating oil plant at Lake Charles, La., being built by Cities Service Oil Co. and Continental Oil Co.

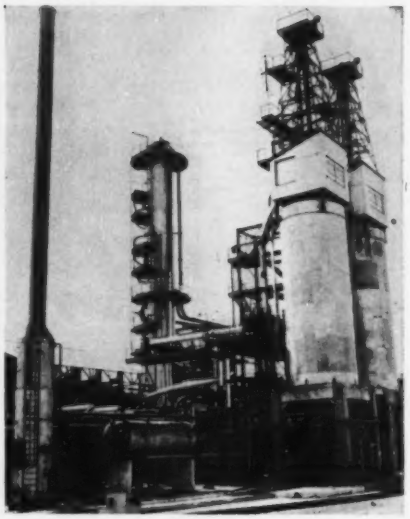
ing oil and other products.

Present capacity of the refinery is about 15,000 barrels daily and will be greatly enlarged by installation of a catalytic cracking unit embodying the latest improvements developed since the war and processing feed stocks from 24,000 barrels of crude daily, utilizing existing facilities for providing this feed. Crude oil will be supplied to the refinery by a pipeline 182 miles in length connecting it with the Rangely field in Colorado. The line has a present capacity of 22,000 barrels daily, which can be raised to 40,000 by addition of a third pumping station.

At Bakersfield, California, Standard Oil Company of California is modernizing and enlarging its refinery to produce greater quantities of gasoline and distillate fuels. One of the major factors in accomplishing this result will be a new crude distillation unit which will replace three batteries of shell-type stills which have been in operation since the plant was built in 1912. Completion of this unit will help to raise the plant's rated throughput of 12,000 barrels to about 18,000 barrels per day. Other installations include a catalytic cracking plant, a product treating unit and a high pressure boiler plant capable of generating steam at the rate of 70,000 pounds per hour. A new office building has been completed and is in use. Products of the plant will be gasoline, diesel oil, heating oil, three grades of fuel oils for industrial use, and asphalt.

At Standard's Richmond refinery a large wax plant has been completed and is now in production. The new plant will produce 45 million pounds per year of wax of high, medium and low melting points. About 29 percent of the output will be of the most pliable low-melting point grade, 125 to 130 AMP, used mainly in milk cartons; some 54 percent will be of medium melting point grade for waxed paper. Higher melting point wax will be made for specialized purposes.

At the same refinery the company has established a package and grease plant said to be the most



Delayed coking unit at Pure Oil Company's Toledo, Ohio, refinery which has enabled the company to reduce its output of residual fuel since completion late last year.

advanced of its kind in the United States. It is equipped for the manufacture of more than 250 miscellaneous petroleum products and for the storage and shipment of nearly every product put into packages, ranging from pharmaceutical white oils to the

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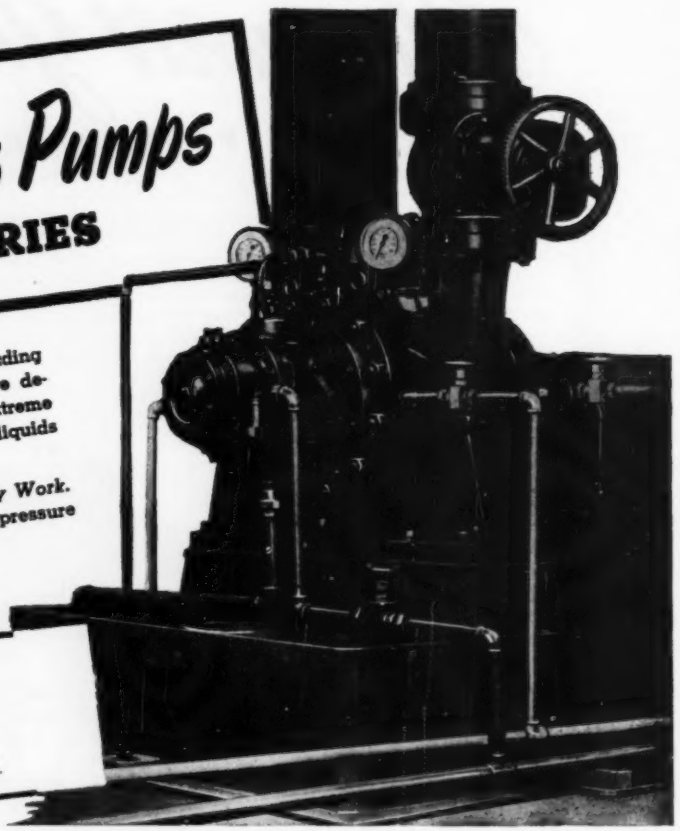

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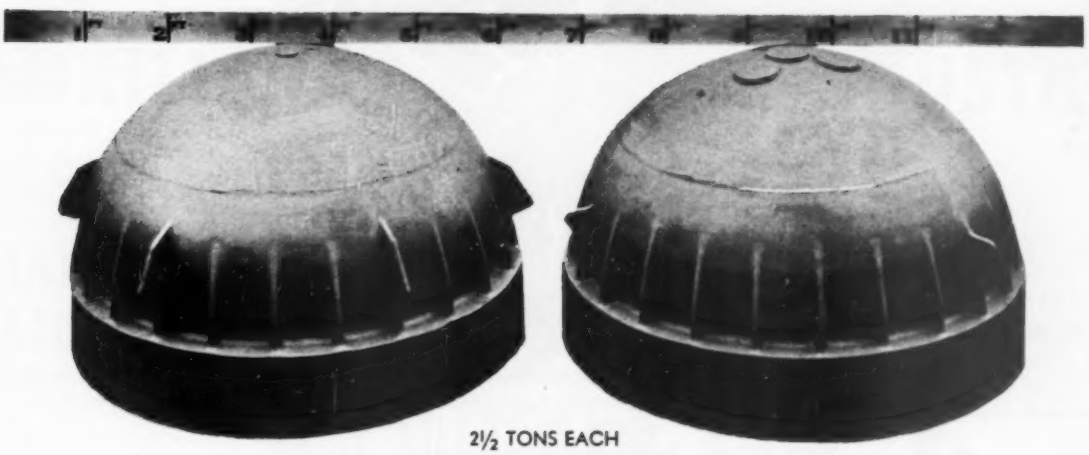

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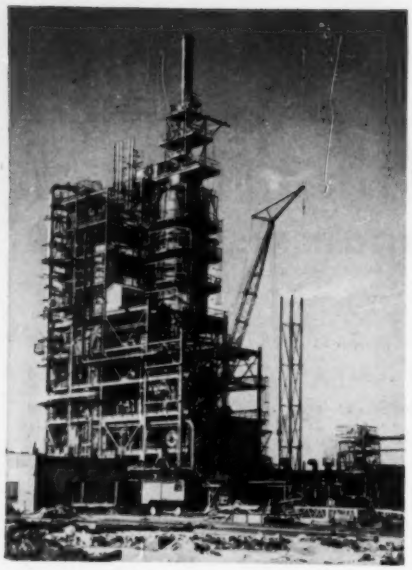


Fluid catalytic cracking unit nearing completion at the Casper, Wyo., refinery of Standard Oil Co. (Ind.) This unit, now in operation, is the eighth which has been built by the Indiana group of companies.

heaviest greases. Stocks are moved through 20 miles of pipelines, and the production of greases, lubricants and specialties is calculated as 38 million pounds per year.

General Petroleum Corporation is improving existing facilities at Torrance, California, by the installation of a vacuum crude distillation unit and additions to its previously constructed delayed coking plant. Shell Oil Company has completed or has in course of construction several additions to its California refineries. These include the extension of asphalt capacity at Martinez, erection of a research and pilot plant laboratory and enlargement of blending and shipping facilities for insecticide preparations. At Wilmington a solutizer plant for gasoline sweetening is being constructed along with the addition of gas compression equipment to the catalytic cracking installation and enlargement of butane storage. The old Trumble type furnaces of the distillation unit are being replaced by others of new and more efficient design.

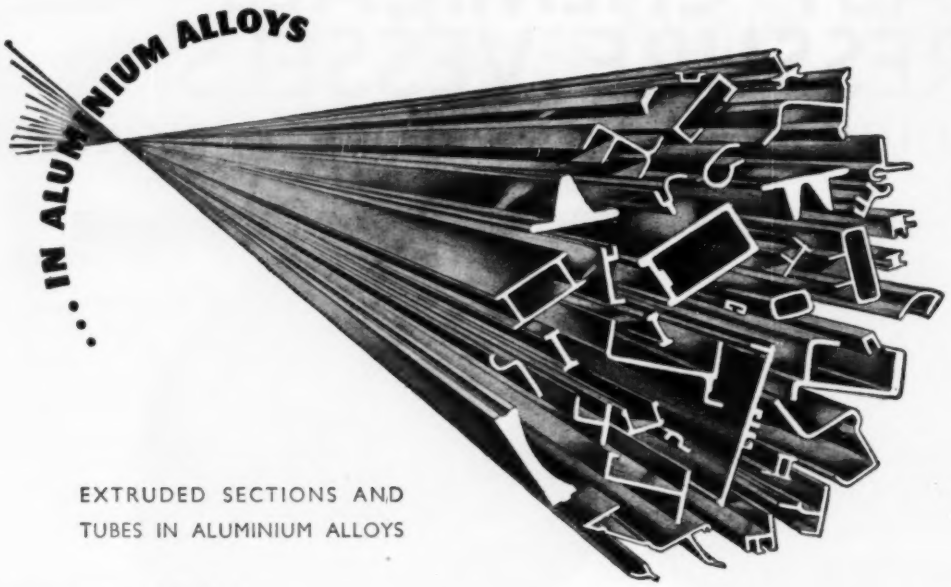
In the four-year period since the close of the war the daily crude oil charging capacity of the United States has been increased approximately one million barrels, from 5,300,000 to 6,350,000. This does not represent the full extent of new construction and expansion, because plants representing roundly a half million barrels have been dismantled or removed. It does not include numerous plants that will be completed during the latter half of 1949. The record shows, however, that the refining industry, in spite of difficulties in obtaining delivery of materials and equipment during much of this period, has been successful in keeping ahead of the rapid increase in demand for petroleum products, although the task has required unprecedented expenditures for added facilities.

Egloff Heads Western Engineers

Dr. Gustav Egloff of Universal Oil Products Co. has just been elected president of the Western Society of Engineers, Chicago. He had been a vice president and trustee of the society for the past five years and in 1940 was the recipient of the Octave Chanute Medal, which is awarded annually by the society in recognition of distinguished service in some field of engineering.

Lowering a 100-ton tower into place during construction work on the new cat cracker at Linden, N. J. Photo by Libsohn for Standard Oil Co. (N.J.)

B. L. RAY has been appointed assistant general manager of the marketing department of Esso Standard Oil Co. in a reorganization of that department. A. R. Martin, formerly assistant southern regional manager, has been appointed acting manager of the cost and operations division. A lubricating sales division has been established, under J. H. Yater, and will be responsible for the marketing of all grades of lube oils, greases and waxes in Esso's 12 field marketing divisions to consumers and resellers.



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Shell refinery at Berre, France, which has been increased to a capacity of 21,600 barrels daily.

Worldwide Refinery Expansion

(Continued from page 63)

minority makes uncertain the prospect of the bill becoming law.

Crude oil production in Argentina during 1948 reached a volume of 23,221,000 barrels, an increase of 1,374,000 barrels over the 1947 figure. Despite this increased production, Argentina had to import more than 25,000,000 barrels to provide enough liquid fuels for its requirements, which reached the unprecedented level of 49,000,000 barrels.

Oil company officials state that imports of petroleum to Argentina will increase during the next few years and will reach some 45,000,000 barrels by 1951. This is due to the fact that oil demand is increasing rapidly, while production is growing much more slowly. No new fields have been discovered during the past five years, and private companies are just exploiting their oil concessions, some of which have been in operation more than 25 years.

One of the noteworthy developments of the past year, in view of the shortage of refining capacity, was the increase in distillation capacity of YPF's La Plata refinery to 50,000 barrels daily. This was accomplished by the addition of a topping unit from the Campina refinery dismantled two years ago and the transformation of a breaker into a primary distillation unit. YPF is actively engaged in erecting the two topping plants purchased from Catalytic Construction Company, having received most of the material and equipment. The units will run Venezuela and Arabian sour crudes at the rated capacity of 18,000 barrels each.

Cia. Ferrocarrilera de Petroleo began operation of its coking plant, designed by Curran Carbonizing Engineering Co. with a capacity of 40 tons of coke per day. The plant has been very successful and is producing a hard coke with a specific gravity of 0.5. This will be used largely in the zinc smelting plant that the company is erecting near its refinery at Comodoro Rivadavia. This plant will have an annual capacity of some 10,000 tons of refined zinc and is to produce the sulfuric acid required by the company for refining processes.

In January YPF took possession of the grounds for the new Buenos Aires refinery. Some of the materials for this project are arriving and foundation work will begin shortly. This is the first of three plants which the government has projected, the construction of which has been delayed by the stringent restrictions on expenditures involving the use of dollar exchange.

One of the small refineries located near Buenos Aires, running on Peruvian low test oil for the manufacture of lubricants, with a capacity of 1,300 barrels per day, is dismantling its present equipment and moving it to a new location. The company is planning to use a large part of its old equipment and construct what it can locally, because of the difficulties in obtaining equipment from the United States at a reasonable cost with the present shortage of dollars in Argentina.

The Direccion General del Gas del Estado is going ahead with the construction of the gas pipeline from Comodoro Rivadavia to Buenos Aires. More than 600 miles of ten-inch pipe have been laid, and it is planned to have the line in operation by the end of 1949. Construction of the main compressor building in Comodoro Rivadavia has already started and the crossing of the Colorado River carried out successfully.

The government has authorized the D. G. del Gas del Estado to build a 300-mile gas pipeline from Plaza Huincul to Gral Conessa in Rio Negro, where it will fit into the Comodoro Rivadavia-Buenos Aires gas pipeline. This project, estimated at a cost of 50,000,000 Argentine pesos, is to ensure the supply of natural gas for the city of Buenos Aires in the future and to take care of expected expansion in the use of natural gas for domestic purposes.

In surveying refining activities in Argentina, mention should be made of the purchase by the Argentine government of the Cia Ferrocarrilera de Petroleo together with the English railroads which formerly owned this company. So far, the company is being run by the same management under Eduard P. Senior as a department of the Ministry of Transports. Whether this will continue in the future is to be seen; the national law regulating YPF activities states that all petroleum exploration, exploitation, industrialization and marketing activities of the government are to be under said department.

Work on Bolivia's two refineries, which was held up by delays in obtaining materials, is now going forward under the direction of Foster Wheeler Corporation. One of these is a combination unit of 5,000-barrel capacity and the other a 3,000-barrel topping plant at Sucre. Completion of both plants is scheduled for 1950. In Ecuador the enlargement of La Libertad refinery of Anglo-Ecuadorian Oilfields, Ltd., has been completed, raising its capacity from 2,000 to 4,000 barrels.

The project for a refinery in Chile is making progress. At Concon near the mouth of the Aconcagua river, north of Valparaiso, a site has been selected and construction is scheduled to start at the end of this year. The location is considered favorable because of its nearness to Santiago and Valparaiso, providing a market calculated at two million barrels a year in the near future. The project calls for a crude oil capacity of 12,000 barrels daily, including a plant for lubricants and paraffin, and the cost is estimated at about $20 million. Completion is expected in 1951.

Expansion of European refining capacity in anticipation of increasing dependence on Middle East crude is strikingly evidenced by activities now under way and by programs adopted for early development. Some of the more extensive of these programs are described in articles on other pages of this issue.

Construction is well under way in Holland by Caltex Petroleum Maatschappij N.V. on a 20,000 barrel-per-day refinery at Pernis, a suburb of Rotterdam situated on the Niewe Maas River. This refinery is destined to

← Erecting storage tank at the Shell refinery at Hamburg-Harburg, Germany.

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Coronado didn't know the color of his money!

SHIPLOADS of treasures taken from Montezuma only whetted the appetite of the Spanish conquistadores. To the captains and grandees came reports of seven fabulous cities to the north—"the seven cities of Cibola." It told of streets paved with gold, of gems set in the building stones.

In 1540 Vasquez de Coronado led a picked band northward in search of the seven cities. Banners danced in the sun above the marching men, the watchers cheered and envied them. It was one of the epics of American exploration. Despite incredible hardships he crossed what is now the panhandle country of Texas and Oklahoma, penetrated into central Kansas. There he was forced to concede that the seven cities were a myth. A thin file of ragged and exhausted ghosts returned to Mexico.

The wealth was there—beneath the feet of the Spanish soldiers. The lands Coronado traversed contained vast treasures of "black gold," petroleum and gas deposits whose value has proved seven times greater than that reputed to Cibola's seven cities.

It was all for the best. The tragedy of imperial Spain was her greed for gold as an end in itself. To America, came men with a true perspective of wealth. They searched out the natural resources, and by their energy and ingenuity converted them into useful products adding to the comfort and convenience of mankind. Two generations of Americans have unquestionably found better use for these riches than would have a whole line of imperialistic kings.

Wildcatters, geologists, engineers, brought forth from the acres over which Coronado rode the raw material of power. Black gold they refined to drive and lubricate automobiles, locomotives, ships and airplanes; to operate factories, to warm nurseries and the skyscraper; by-products to smooth the surface of our roads, chemicals for drugs, and plastics and insecticides.

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Launching a vessel in Britain for towing to Holland, where it was erected in Shell's Pernis refinery.

help supply the needs of the Benelux countries, and its completion is expected in February 1950, at which time runs of motor gasoline, illuminating and power kerosene, diesel fuel and fuel oils will begin.

Being built by Arthur G. McKee & Co., this modern plant will process crude by the newest scientific methods from the initial distillation to the finished products. The Pernis refinery will consist of a two-stage crude unit, a 6,500 barrel daily thermal reformer, a 6,400 barrel Dubbs thermal cracking unit, a non-selective polymerization unit capable of producing 900 barrels daily of polymers, a 16,000 barrel Edeleanu SO_2 extraction plant, and the necessary treating and finishing facilities. In addition a complete laboratory, workshops, offices to accommodate a staff of fifty, a warehouse, cafeteria, locker room and firehouse will be erected. The cafeteria will serve a midday meal to 200 employees. There will also be a complete first aid station maintaining its own ambulance.

A number of houses are being erected on the refinery site for operating executives. Accommodations for 260 families are being arranged for refinery employees in a new housing project under construction in the nearby municipality of Vlaardingen and will be ready for occupancy late in 1949. The refinery expects to employ around 350 persons, all of whom will be Dutch nationals with the exception of a few key personnel, such as W. A. Schmidt who has been appointed manager of the refinery and is now in Holland. Mr. Schmidt, has had varied refinery experience, during which he has been superintendent of the Canol refinery, Whitehorse, Yukon Territory, and assistant superintendent of the Bahrein refinery, Persian Gulf.

Being constructed on 104 acres of reclaimed land, the Caltex refinery has presented some special problems to its engineers. Soil conditions are such that all major equipment must be supported on piles varying in length from 40 to 90 feet. The entire installation will require 2,500 fifteen-square-inch reinforced concrete piles. Settlements up to 18 inches are expected to occur during the early years as the result of soil consolidation in recent fills, and this requires careful planning of pressure water lines, sewer lines and other underground piping. Because of the possibility of uneven settlement, the designers decided that floating roofs of any type would be out of the question. Consequently all tankage at Pernis will be cone roofed. Full flexibility has been provided for all piping connections to these tanks. In accordance with existing Dutch laws, impounding basins providing 50-100 percent of tank contents, depending on the stock in each tank, will be built for each tank or group of tanks.

Storage tanks up to a maximum of 32 feet in height are being supported without the use of piling. Soil consolidation beneath these tanks is expected to reach a maximum of 65 inches. Sand pads are being placed under each tank equal to the estimated amount of consolidation. Storage facilities will be provided for approximately 1,600,000 barrels of crude oil and petroleum products.

The site is bounded on one side by the river and on a second side by a dredged harbor, both of which provide excellent deep water anchorages for tankers and barges. This is important because not only will crude be brought in by tankers, but almost 80 percent of all finished products will be distributed from the refinery in barges which will be loaded with finished products up to the rate of 3,500 barrels per hour.

The tanker wharf has a minimum of 34 feet of water and is equipped with hose derricks, bunkering connections, steam, city water, electric power and other usual utilities. Crude will be received through a 16-inch line and unloading rates from 8,000-10,000 bhp are expected. Barge shipments will be made from a second wharf which will accommodate four 400-ton barges Six and ten-inch diameter lines have been provided for loading eight products simultaneously. Both the barge and crude wharves are equipped with slops and dirty ballast return lines to eliminate possible pollution of the river. Two road truck and six rail tank car

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Site of the refinery to be built at Cartagena, Spain. Tankage and various buildings are in place in advance of processing units.

loading spots are provided for distribution of products to local markets.

The steam generating plant contains two high-pressure boilers, each capable of generating 150,000 pounds per hour at 250 psi and 750°F total temperature. Water from the Rotterdam municipal system is fed into the boilers after having been treated by a hot lime and soda process. Air compressors, located in the boiler house, will furnish 2,000 cfm of utility air to the refinery at 100 psi and 1,500 cfm at 50 psi for process control instruments. The thermal cracking unit steam generators will produce from waste heat an additional 45,000 pounds per hour of steam at 165 psi and 450°F total temperature.

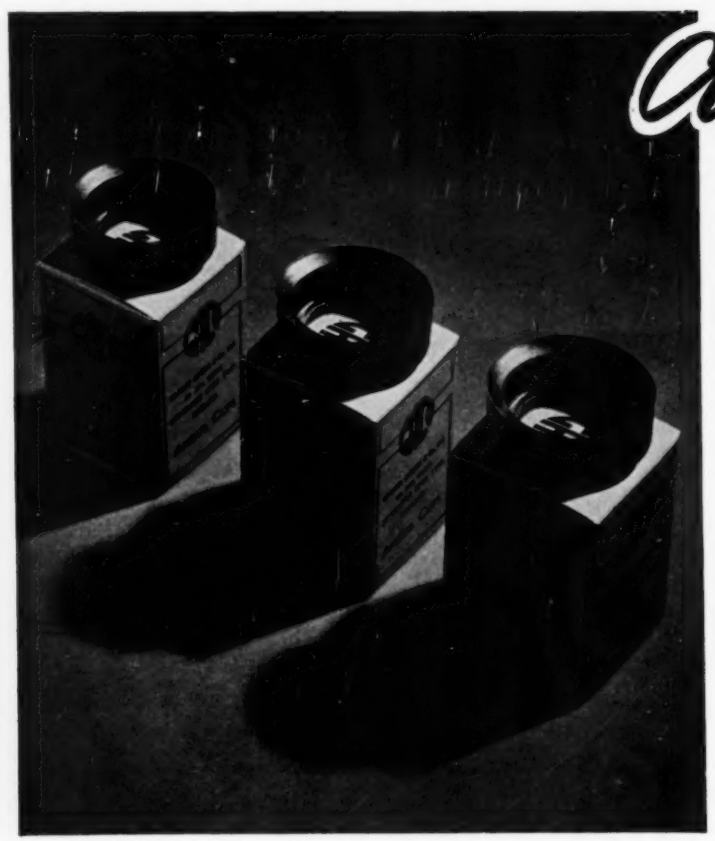
A pumping station will supply 864,000 gallons of cooling water per day for the refinery from the Niewe Maas River. The cooling water pump drivers are designed to operate on low pressure steam. As the requirements for low pressure steam for heating purposes increase during the winter months, a maximum of 3,600 pounds per hour can be bled from the pump driver turbines and supplied to the refinery. During the warm summer months, low pressure steam not used for heating purposes will be fully utilized by the pump driver turbines as the demand for cooling water reaches its maximum. An additional pumping system will produce 2,500 gallons of water per minute at 150 psi for fire protection.

The Pernis refinery will require an estimated 20,000,000 KW hours of electrical power per year to be purchased from the Rotterdam municipal system.

Oil-free cooling water will be discharged from the refinery into the river through separator pits similar to the API design but without flight scrapers. All oil-contaminated sewers will discharge into a two-stage API separator with flights which will retain the oil and prevent pollution of the river. Of interest is the fact that the water level in the oily water separator will be below the river level, and it will be necessary to pump the effluent into the river.

An interesting feature of the fire protection system will be the fixed air foam connections on each storage tank. A fixed system is required by Dutch laws, but would be necessary in any event because of the cone roof tanks in light oil service. Fixed air foam generators are installed at each tank with lines running to the outside of the impounding walls. In the event of a fire, it is then proposed to hook a trailer truck or protein foam solution to the hydrant in such a manner that the solution will be educted into the fixed tank lines.

Prior to the war the Royal Dutch-Shell Group maintained a refinery of about 10,000 barrels daily capacity at Pernis. Most of the equipment of this plant was destroyed by bombing or was carried away by the Nazis during the period of their occupation. It is now being rebuilt to much greater capacity, and when the work of reconstruction is completed in 1953, it will process 30,000 barrels or more per day. The enlarged plant is



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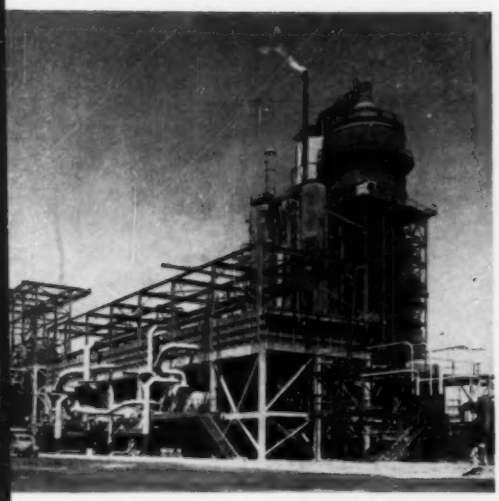


Fluid Catalytic Cracking Unit at Bahrein. Closed in 1945 because of decreased demand for aviation gasoline, now being reconditioned to produce motor fuel. Robert Yarnall Richie photo for California Texas Oil Co. Ltd.

being constructed around the original refinery adjoining the petroleum harbor which is being built by the Rotterdam municipality. It will include not only the most modern installations for the processing of crude into all commercial forms of petroleum products but greatly enlarged facilities for transfer and storage, including tanker berths and jetties for handling sea-going tankers and canal barges. Adjoining the refinery site a chemical plant will be erected for the production of chemical products from petroleum. While the refinery will draw a large part of its crude supply from the Middle East, it also handles the domestic production of the Netherlands developed during the war and now amounting to about 10,000 barrels daily.

Plans have been drawn for enlargement of the plant of N. V. Vlissingsche Mineraalolieen Asphalt Raffinaderj at Rotterdam, which is devoted mainly to the production of bitumen.

Belgium also is to have increased refining capacity through construction at Antwerp of a new plant by the Societe Industrielle Belge de Petroles, which is jointly owned by Anglo-Iranian Oil Company, Ltd., and Petrofina. A site of 150 hectares (370 acres) has been leased from the Port of Antwerp. When completed the plant will have a crude distillation capacity of 30,000 barrels daily and will include thermal cracking and reforming. It is expected that it will be ready for operation in 1951 or 1952.

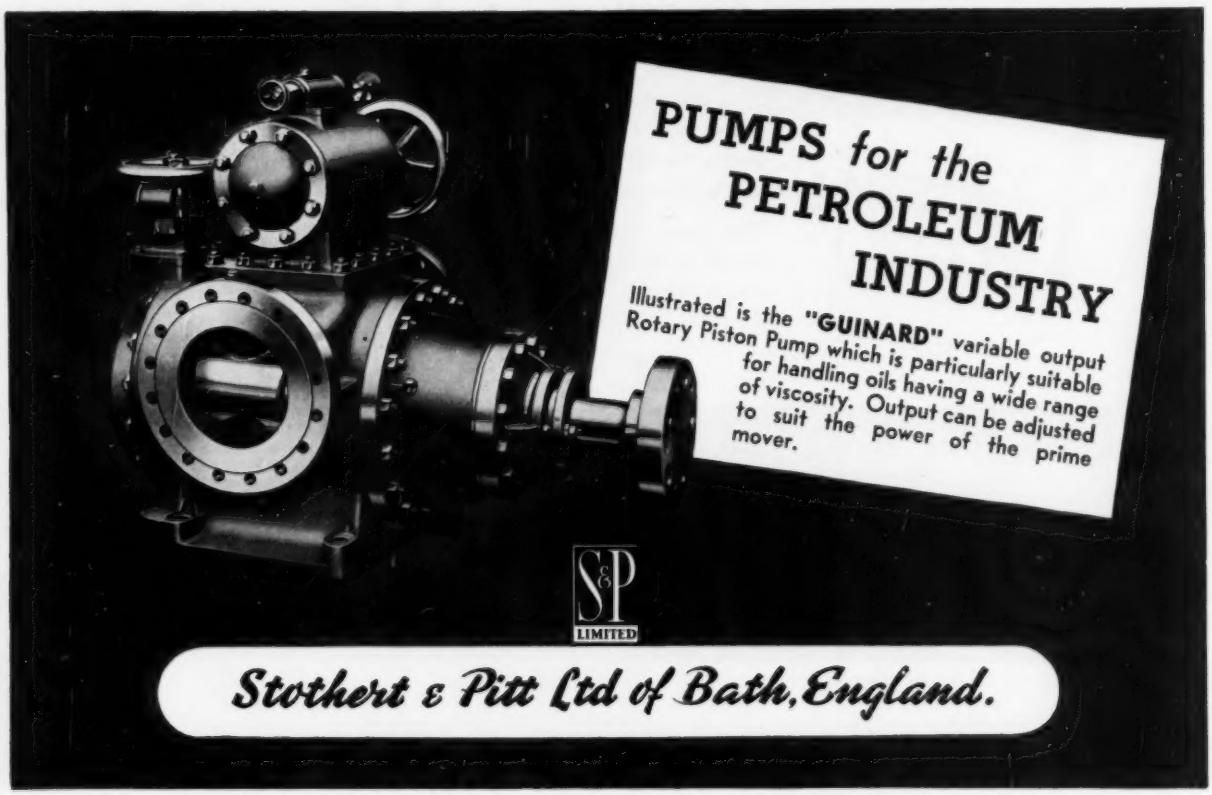
Raffinerie Belge de Petroles S.A. at Antwerp is adding to its capacity by installation of a crude distillation unit of 2,000 barrels daily capacity, gas oil cracking units, naphtha reforming unit, gas recovery plant and enlarged power plant. A portion of the equipment has been purchased from a company in California and is being dismantled, reconditioned and shipped to its new location by W. M. Barnes Company of Los Angeles.

In France the reconditioning of war-damaged plants is well advanced, and several refineries are operating at capacities above their prewar rating. Cie. Francaise du Raffinage is enlarging its throughput by addition of a 20,000-barrel crude distillation unit and is installing a lubricating oil plant. Socony-Vacuum Oil Company has two subsidiaries operating in France, Cie. Industrielle des Petroles at Frontignan and Raffineries de la Vacuum Oil Cie. at Gravenchon. The latter was almost completely destroyed during the war and is being rebuilt for enlarged capacity and for more complete processing of products. New units under construction include MEK dewaxing, propane deasphalting, furfural extraction and clay contacting. A rather complete rebuilding of prewar facilities for compounding and grease making and thermal reforming form a part of the rehabilitation. All of this work is now in process and is scheduled for completion about the middle of 1950. The refinery at Frontignan is being enlarged by installation of a crude distillation unit. It will be devoted mainly to the output of black and white products.

Raffineries de Petrole de la Gironde, Caltex affiliate, is virtually rebuilding the Ambes refinery near Bordeaux. The work here, being done by Arthur G. McKee & Co., is over one-quarter finished, and it is expected that early 1950 will see its completion. It involves the construction of a completely new 13,000-barrel daily atmospheric crude distillation unit and reconstruction of the war-damaged thermal reforming unit to an increased postwar capacity of 3,200 barrels daily. Most of the remaining refinery units are being repaired or reconstructed without major additions or changes. The refinery has been so designed as to permit the addition of cracking facilities at a later date. Existing steam and electric installations suffered little damage during the war and are being reconditioned to furnish 111,000 pounds of steam and 1,300 KW of electricity per hour.

A new pumping station, utilizing many of the prewar pumps, will supply cooling water at the rate of 10,600 gallons per minute from the nearby Dordonne River. Storage facilities especially suffered wartime bomb damage. Only 412,000 barrel storage capacity remains usable or repairable. When completed, the Ambes refinery will have a total storage capacity of 1,350,000 barrels.

All crude oil for the refinery will be received, and some of the finished products shipped, from an existing public wharf. The local port authorities are construct-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ing an additional wharf to handle the balance of the finished refinery products.

Requiring housing for its estimated 325 employees, the refinery with the cooperation of local housing authorities is providing suitable housing facilities for employees and their families. Twenty-two residences, a club house and a cafeteria capable of serving 300 are under construction. The cafeteria will obtain a part of its food from its own gardens planted in unused areas of the refinery site reserved for future expansion.

In the fighting about Dunkirk the refinery of Soc. Generale des Huiles du Petrole, French subsidiary of Anglo-Iranian Oil Company, Ltd., was almost completely destroyed. A plant is being erected on a new site which will have a daily capacity of 30,000 barrels on its completion in 1951. Some equipment from the company's plant at nearby Courchelettes is being incorporated in the Dunkirk refinery, which among other features will have a lube plant of 1,000 barrels daily capacity.

The Berre refinery of Cie. de Raffinage Shell-Berre, which is the principal plant of Shell's French subsidiary, is being reconstructed to an enlarged capacity of 47,000 barrels with completion set for 1951.

With the completion of these plant changes, France will be amply equipped with refining capacity for domestic requirements, even with the considerable growth in consumption which is anticipated.

Spain's ambition to possess a modern refinery is soon to be satisfied.

On June 28 Escombreras Petroleum Refinery, S.A. was organized for the completion and operation of a refinery at Cartagena. Caltex Oil Products Company in New York holds 24 percent of the capital investment. The balance is held by Spanish interests: 52 percent by the National Institute of Industry, 24 percent by the Spanish Petroleum Company, S.A.

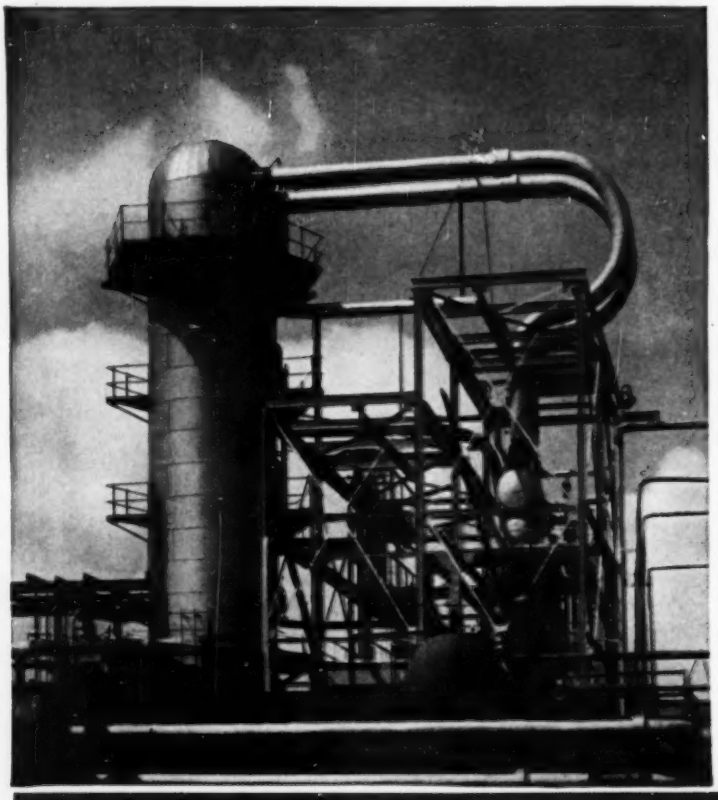
The capital of the new company is about 325 million pesetas ($29,835,000). The refinery is well advanced in its construction; the first stage will be ready to start operations by the end of this year at a capacity of 5,000 barrels per day. Designs are now under way to complete the refinery and to increase its capacity to 20,000 barrels per day. The completed refinery will have the most modern equipment for crude distillation, thermal reforming, polymerization and other facilities for the production of high-grade petroleum products including gasoline, kerosene, fuel oil, lubricants, paraffin wax and asphalt.

Little information is available from the countries of eastern Europe that lie behind the Iron Curtain. A recent report by the Soviet Union on progress of the current five-year plan gave no details on refining development but said that it was behind schedule owing to slackness in the delivery of equipment. Romania, once an important supplier of petroleum to western Europe, has disappeared as a factor in international trade, its diminishing surplus being absorbed entirely by Russia. Similarly the oil industries of Czechoslovakia and Hungary have become mere appendages of the Soviet Union. In Jugoslavia Marshall Tito's program of industrialization contemplates an increase in oil production and the establishment of refineries to process the output. The industrialization plan is reportedly involved in negotiations at Washington for a loan to Jugoslavia.

Proposals earlier discussed for construction of refineries on the eastern shore of the Mediterranean have been held in abeyance because of unsettled political conditions and may be modified by decisions to erect large capacity plants in Europe. Consolidated Refineries Ltd. at Haifa, Palestine, jointly owned by Shell and Anglo-Iranian, has been idle since the early months of 1948. Anglo-Egyptian's refinery at Suez has been enlarged by addition of a 14-000-barrel crude distillation unit. Abadan refinery of Anglo-Iranian, which is constantly undergoing expansion, has raised its charging capacity to 500,000 barrels per day. Two additions now under construction are a catalytic cracking unit of 35,000 barrels daily capacity and a small lubricating oil plant of 400-barrel capacity. Kuwait Oil Company is about to construct a 20,000-barrel topping plant to process crude from its Persian Gulf concession, mainly for the production of fuel oil and ships' bunkers.

Bahrein Petroleum Company, Ltd., has under way an extensive program in Bahrein, Persian Gulf, which is designed to provide a well-balanced refinery at the present level of crude throughput. A new thermal reformer and auxiliary facilities have just been placed in service, bringing the reforming capacity of this refinery up to 21,000 barrels per day. An 18,000 barrel per day vacuum unit, which will charge atmospheric reduced crude, will be brought on stream this month. A 55-000-barrel per day crude unit will be ready for service during the latter part of 1950 and will replace equipment which is at present temporarily in crude processing service. Tankage is being erected to bring storage capacity up to a satisfactory level at present operating rates. Power facilities are being expanded by the provision of two boilers and two turbo-generators. The first units of this equipment are now being tested and the remainder will be ready during the early part of 1950. A new laboratory, additional office space and more housing units for employees are being provided in this program.

In the Far East the two large refineries of Standard Vacuum and Shell in south Sumatra are both back in full operation, following repairs which have been under way since the close of the war. In the northern



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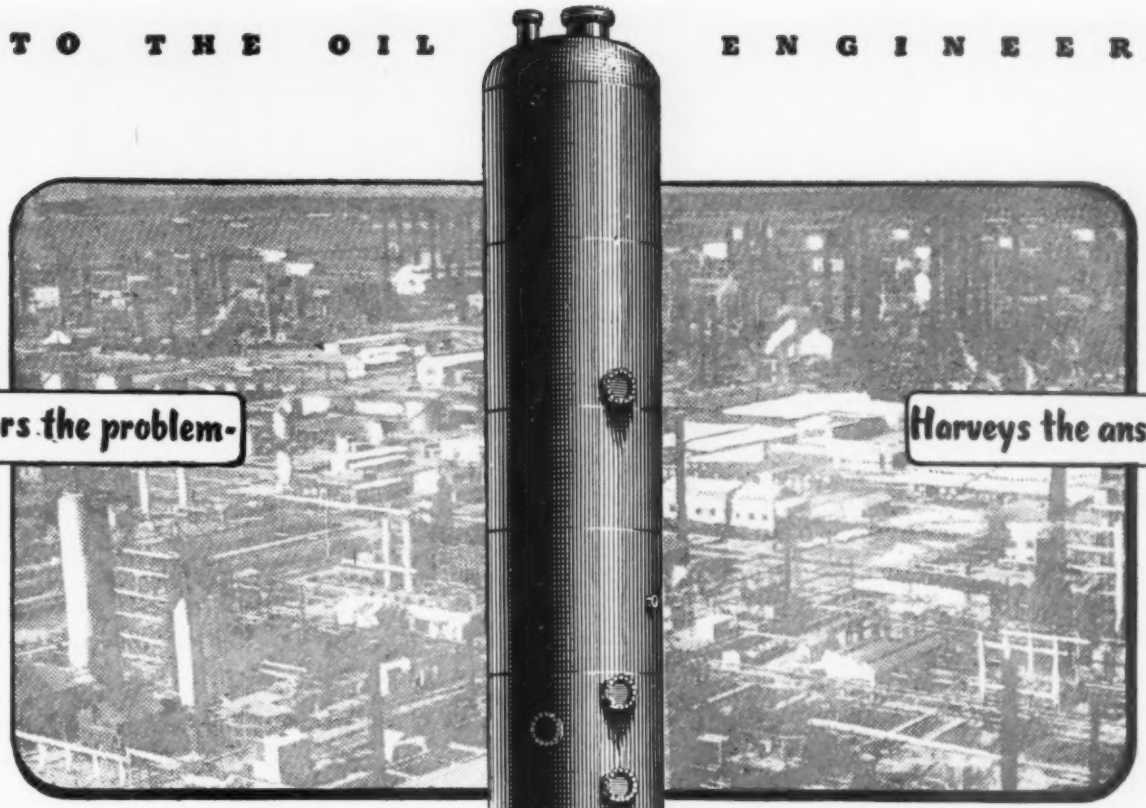

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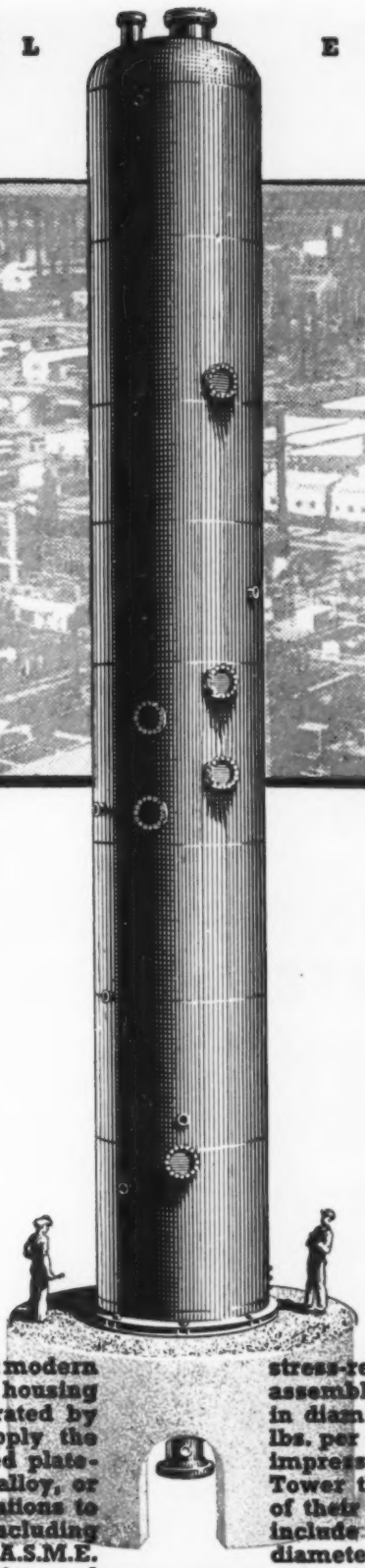

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part of the island Shell's Pangkalan Brandan plant remains in badly damaged condition and inaccessible to the owners. In Borneo both production and refining have proceeded at a full normal rate.

In Australia Vacuum Oil Pty., Ltd., subsidiary of Standard Vacuum, completed its bitumen plant at Paisley, and Shell Co. of Australia, completed a similar plant at Clyde. Shell's distillation unit has been processing up to 5,000 barrels daily of crude oil shipped from Borneo.

Largest V-Type Diesel Announced

Further economies in the cost of power are being predicted by the announcement by The Cooper-Bessemer Corp. of what is believed to be the largest and most compact diesel engine of its type in the United States. Operating either as a conventional oil-burning diesel gas engine or as a gas-diesel unit, this engine is reported to deliver more horsepower per cubic foot of space than any known comparable engine today.

The new V-type engines are 16-cylinder, gas-diesel units rated 3,300 hp per unit at 327 rpm. These engines will require only 275 square feet of floor space, or 12 hp per square foot. This compares with nine hp per square foot as produced by other engines in this type of service. In addition to the large 16-cylinder units, however, Cooper-Bessemer will build both supercharged and atmospheric LSV-type engines in a 12-cylinder size, affording a total range from 1300 to 3300 horsepower.

The Cooper-Bessemer LSV engine, being of the V-type, is built with two banks of cylinders, 15½-inch bore and 22-inch stroke, driving a single crankshaft by means of articulated connecting rods. Aside from conversion to V-type, other new refinements include unusually low bearing pressures, motor-driven pumps, dual superchargers, exceptionally low head room, larger 13½-inch diameter crankshaft.

H. W. Nelson

Fred J. Underwood

Barnes Co. Opens Two New Offices

John Ford, Jr., vice president of the W. M. Barnes Co., recently announced the opening of new company offices at 654 Madison Ave., New York City, and at 10053 Jasper Ave., Edmonton, Alberta, Canada. The latter office will be known as W. M. Barnes Co., of Canada, Ltd.

The New York office will be under the direction of H. W. Nelson, recently appointed vice president of the company. Mr. Nelson is also president of the H. W. Nelson Co., an organization that has been primarily engaged in railroad construction since 1910. The new office at Edmonton, Alberta, will be managed by Fred J. Underwood. Mr. Underwood was the project manager in charge of erection of the large refinery just completed by the W. M. Barnes Co. for Imperial Oil Ltd., at Edmonton.

LAWRENCE WOLFF, formerly manager of general sales, has been appointed assistant to A. C. Stewart, vice president in charge of marketing of Union Oil Co. of Calif. Roy Linden, formerly manager of the company's northwest territory with headquarters in Seattle, was named as manager of general and foreign sales. F. K. Cadwell was named manager of the northwest territory. Mr. Cadwell had been district sales manager for Tacoma. Mr. Wolff has been associated with Union Oil for 37 years. He joined the sales department in San Francisco in 1912.

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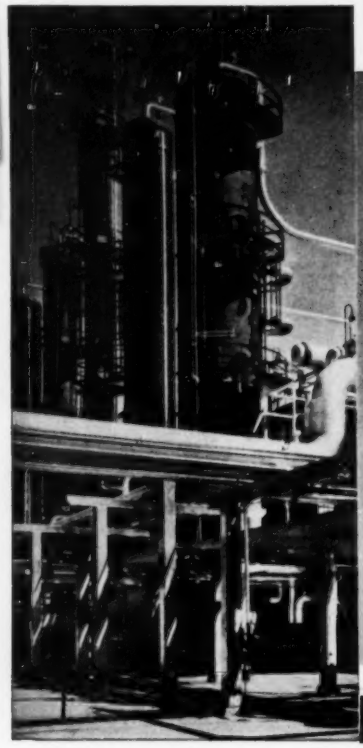

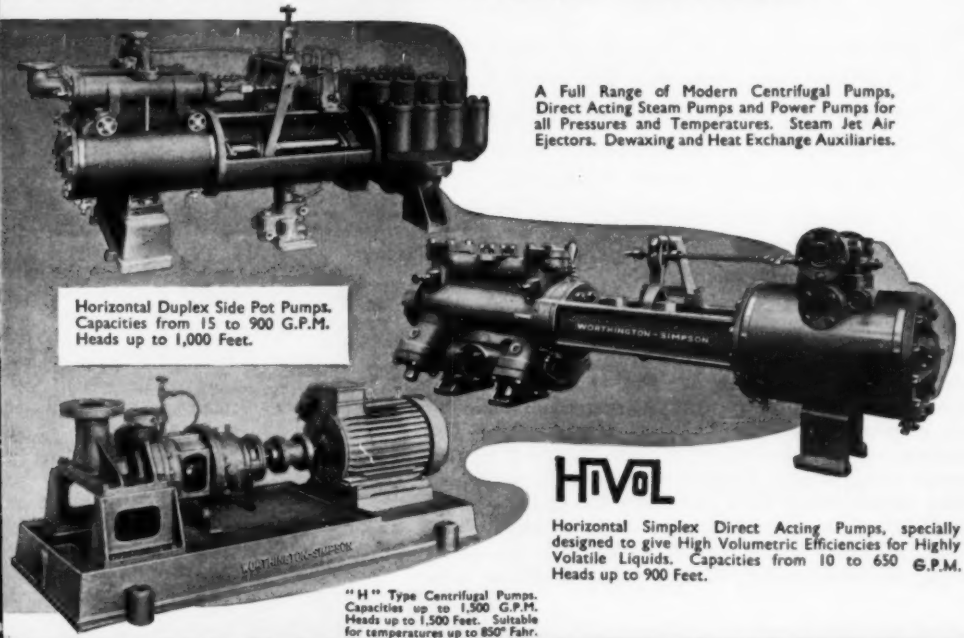

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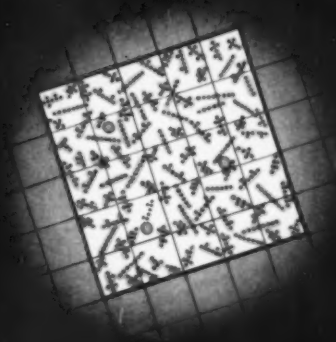

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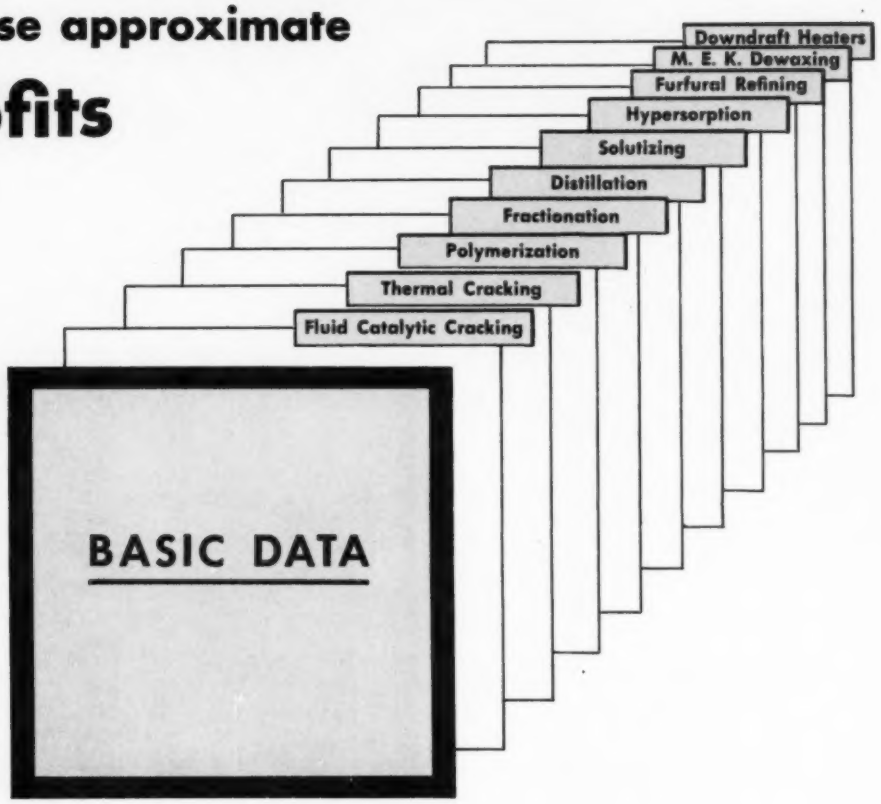

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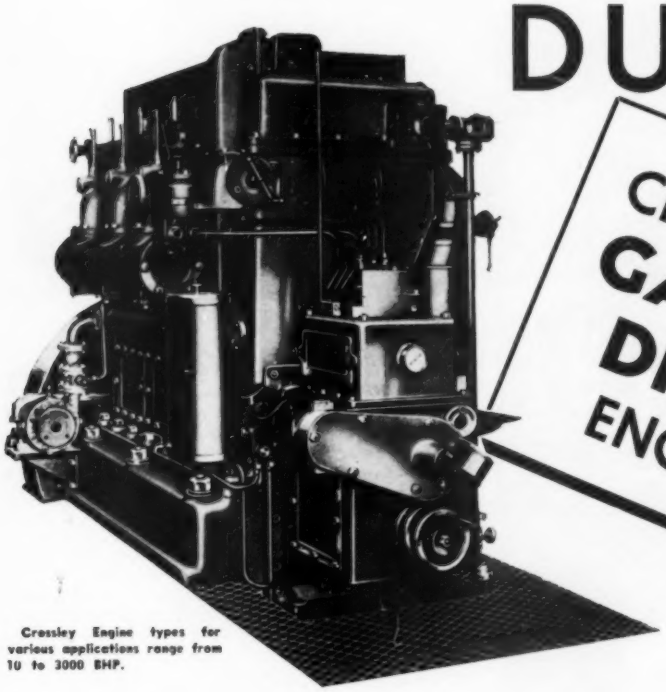

CROSSLEY GAS-DIESEL ENGINES

Crossley Engine types for various applications range from 10 to 3000 BHP.

The illustration shows a three-cylinder 130 BHP—500 RPM Crossley Dual Fuel Engine, designed to use all descriptions of Diesel oils, Town gas, Suction gas, Sewage gas, Natural gas, and Blast Furnace gas.

The change over from one fuel to another is accomplished by simply moving a lever whilst the engine is running. There is no dismantling of parts, thus saving time normally spent in a change over.

The amounts of oil and gas in use can be varied from the very small quantity of oil required for ignition, to any greater quantity up to 100 per cent of oil. This is useful in cases where the supply of gas varies, such as with Natural or Sewage gas.

The Engine is totally enclosed, and marks a big step forward in the convenience with which a change over from Gas to Diesel Oil, or vice-verse can be made.

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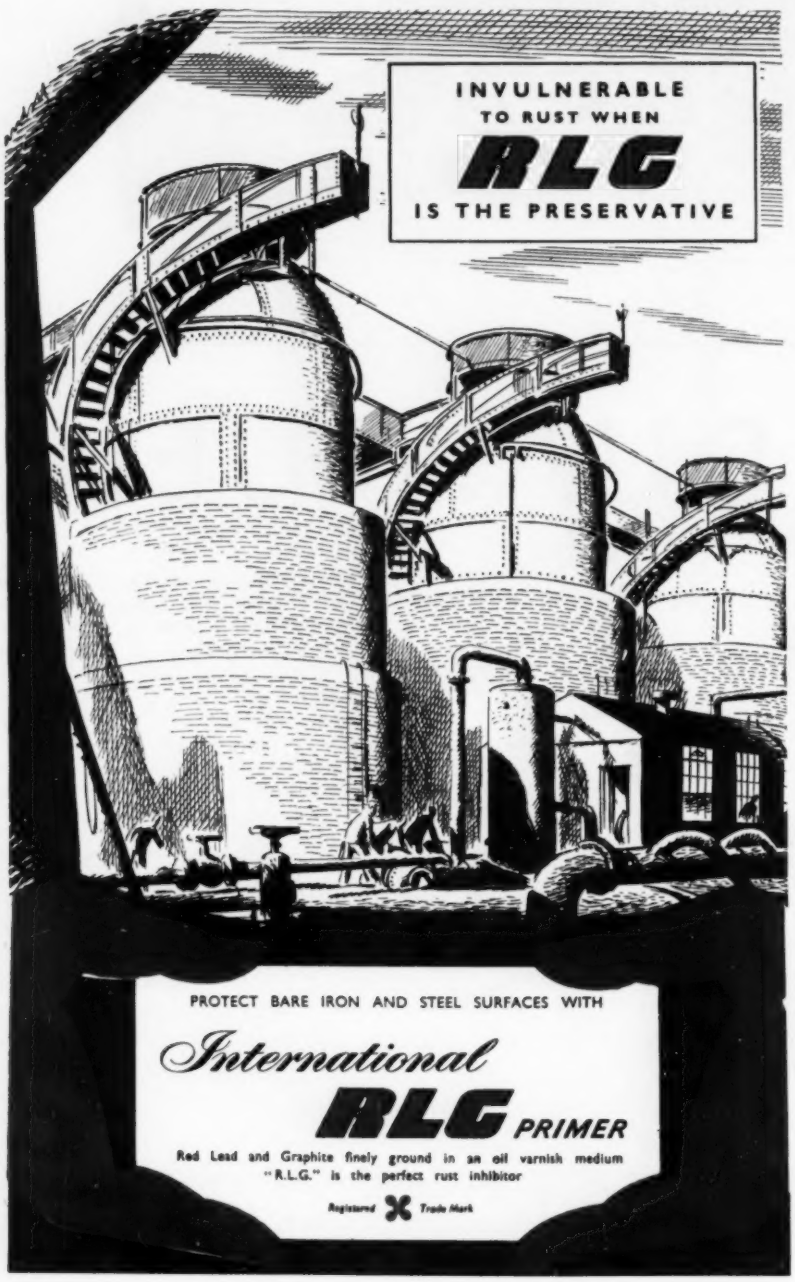
Signs Japanese Agreement

Thomas Bryan & Associates, Inc., Houston, has announced an agreement with Nippon Kihatsuyu Kabushiki Kaisha (Japan Gasoline Company Ltd.) to collaborate in the engineering design and reconstruction of Japan's chemical processing and petroleum refining industries. Japan's refineries were largely destroyed by bombing during the war, and one of the first directives of occupation forces shut down the few remaining refineries in the Pacific Coast and Inland Sea areas of Japan. Refineries located in the Japan Sea Coast producing area were permitted to continue processing of their domestic crude, but this accounts for very little of Japan's needs and provides nothing for export. Recently the Japanese companies have been negotiating new agreements with foreign oil companies again to secure their crude for refining, and new plants are being contemplated to refine crude imports.

Masao Saneyoshi, president of Japan Gasoline Co., states that such names as the Nippon Oil Co. and Caltex have been linked in current negotiations. Also mentioned in reported negotiations are Showa Oil Co. and Shell; Toa Fuel and Standard Oil; Mitsubishi Oil and Tide Water Associated. Japan's domestic demand is not large enough to absorb heavy imports of crude, but should GHQ permit oil companies to export refined products to the Asiatic countries, the construction of new and modern units would become an immediate necessity.

A. C. Atwater, manager of the Houston firm's chemical and petroleum division, spent considerable time in Japan prior to the war. At that time he was prominent in the development of Japan's oil refining industry.



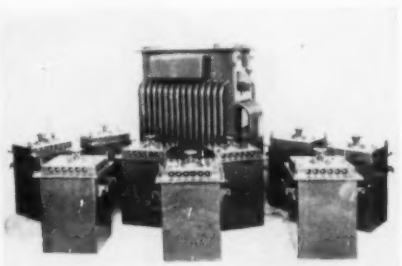
Heat Exchanger Baffles

Henry Vogt Machine Co., Louisville, Ky., has published a pamphlet describing its new positive seal baffle for two-pass heat exchangers. The baffle consists of a solid plate inserted between the tube sheets of the tube bundle, having outwardly opening channels on each side. After inserting the tube handle in the shell, there is loosely placed in each channel, in the order named, a compression mechanism composed of a longitudinal series of pivotally connected steel links, a steel backing strip and a suitable packing.

To seal the baffle after the bundle is in position and prior to bolting on the cover of the unit, it is only necessary to turn the nut of the compression screw on the end of the compression linkage so that it bears against the locking washer. A stop in the other end of the baffle channel forces the adjacent end of the linkage, as well as the intermediate links, in a toggle-like action outwardly against the backing strip. Each link adjusts itself individually to transmit equal pressure along the length of the packing as it conforms to any unevenness of the shell. To remove the bundle from the shell, the seal is broken by backing off the compression nut whereby the linkage is retracted and pressure is removed from the packing.

Welding Plant

The Quasi-Arc Company, Ltd., of Bilston, Staffordshire, recently exported a multi-operator welding plant with unusual features. The installation comprises a transformer and nine independent welding current regulators providing an output of 35 to 450 amperes for each welding operative. The transformer has an unusual stepdown ratio of 10,000/173 volts. The primary side is wound for a 10,000-volt, three-phase supply at a frequency of 42 cycles per second. The primary windings are tapped at plus and minus five percent, and the links for the change are manually operated by an off-circuit tapping switch. The welding voltage between each phase and neutral on the secondary side is 100 volts. The transformer is continuously rated to B.S.171 at 183 KVA and suitable for a maximum output for welding purposes of 405 KVA in conformity with B.S.638.



The regulators provide a close welding current adjustment between 35 and 450 amperes. Selection of the desired output is made from five current range plugs, and final regulation of the welding current is obtained by a 10-position radial knife switch operating on any one of the five output ranges.

Heads Sales In New Orleans

D. L. Markle, Jr., has been appointed district sales manager in charge of the New Orleans office for The Youngstown Sheet and Tube Co., succeeding Orville B. Ewing who died recently. Mr. Markle was a salesman in the Dlass, Texas, area until April 1949 when he was transferred to New Orleans because of the illness of Mr. Ewing.

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Mobile Testing Laboratory

A mobile petroleum laboratory for the field testing of petroleum fuels and lubricants, lightweight enough to be carried by air and embodying all the refinements developed since the end of World War II, has been delivered to the Quartermaster Corps by the Precision Scientific Co. of Chicago. Unlike the improvised mobile laboratories used in overseas battle areas during the war, the new equipment is completely self-contained and independent of other sources for electrical power, heat control or other requirements. Special equipment in the laboratory is capable of maintaining any critical range of temperatures necessary for precise analysis, including tests down to —100°F. The laboratory is equipped to test all grades of gasoline, fuel oils, lubricating oils and greases.

Welding Accessories

Murex Welding Processes, Ltd., Waltham Cross, Herts, England, has published a new catalog M-41 describing welding accessories manufactured by the company. The catalog lists other publications of the company including welding manuals, training courses, data on the welding of aluminum and other non-ferrous metals, cast iron and stainless steel. Copies of Catalog M-41 are available on request.

Oil Movies

A catalog of motion pictures about the oil industry which tells where and how they may be obtained has been prepared by the API Oil Industry Information Committee. In addition to telling how and where interested persons and groups may obtain the films for showing, the catalog gives such details as the length of each film, whether or not it is in color and is sound or silent.

Fluid-Motor Operator for Valves

Crane Co., Chicago, has announced a simplified fluid-motor operator for gate valves. This new design makes possible extensive use of motor operated valves, since the actuating unit can be easily adapted to standard valves in stock or to valves already installed. This previously has been a virtual impossibility, for motor-operated valves have customarily been made up on special order to the requirements of the installation. The device can be operated by water, oil or compressed air or gases.

Silicone Rubber

During the past two or three years there have been many references in the technical press to silicone rubber, particularly as regards its ability to retail its elasticity at temperatures both above and below those possible with natural or other types of synthetic rubber, but it is not generally known from what sources processed silicone rubber can be obtained.

For the past two years Richard Klinger, Ltd., Sidcup, Kent, has been experimenting in the extruding and molding of the various grades of silastic rubber marketed in the United Kingdom in the unprocessed state by Messrs. Albright & Wilson, Ltd., and Klinger is now in a position to execute orders for this class of work. The grades chiefly being used are silastic 160, silastic 161 and silastic 181, which can be supplied in the form of sheets, moldings or extrusions.

Invites Capital Participation

Dr. J. E. del Hierro, Colombian minister of petroleum, has appointed Martin del Corral and Fernando Salazar to assist in the development of plans under which private capital may be invited to participate in the government-sponsored oil company, Empresa Colombiana de Petroleos." The proposed company, established primarily to take over the De Mares concession when it expires, is to be formed with both foreign and local capital. The government will contribute the properties as its share of the project.

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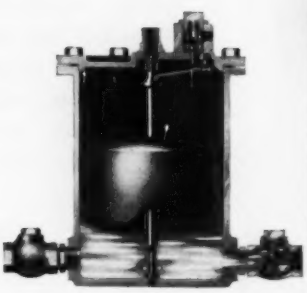
The big new "red book" is off the press, the 27th edition of The Petroleum Register, completely revised and with 5,000 new listings of oil and allied companies in 130 countries. Price is $15 postpaid. Order from THE PETROLEUM REGISTER, 318 South Central Ave., Los Angeles 13, Calif.

This patent



AUTOMATIC PUMP

combines the good qualities of a pressure pump and a vacuum trap. Pumps condensate from low-pressure or vacuum vessels and lifts up to fifty feet; pumps boiling, cold or gaseous fluids (including oils); pumps petrol, benzine, dye liquors and alkaline liquors such as caustic, ammonia, etc.; drains sump holes, pits, excavations (where it may be fully submerged). ENTIRELY AUTOMATIC. *Details of "Ogden's Patent Pump" (in five sizes) from:* OGDEN & CUNLIFFE, (Petroleum Dept.) Charlton House, Cheltenham, Glos., Eng.

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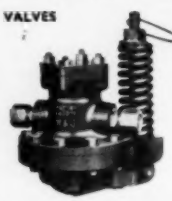

Designed by experts to give a minimum sympathetic pressure drop with variations of upstream pressure. Maximum flow with minimum working drop and absence of pressure creep with no flow. Leaflet No. 43 gives full details.

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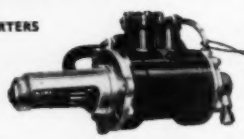

Air Starting Motors for Compression Ignition Engines and Gas Turbines. Robust, reliable, easy to install and economical in operation. For use with engines from 20-BHP to 750-BHP. Fire risk eliminated. Leaflet No. 32 gives full details.

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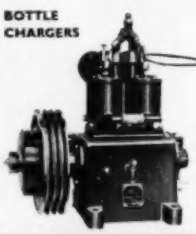

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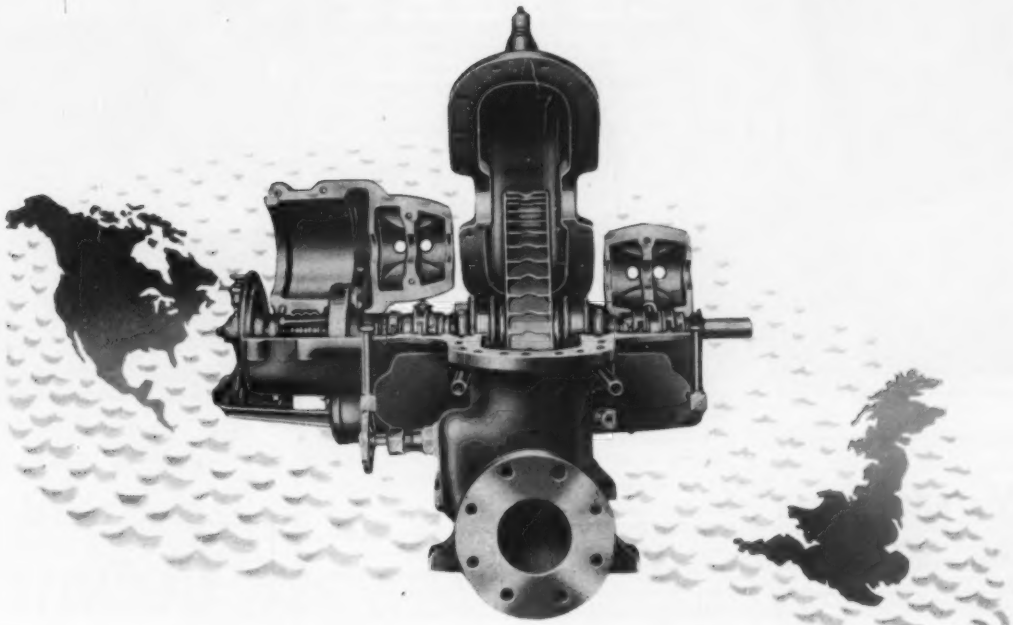

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Following upon the Hayward Tyler-Byron Jackson SM, VC, and DSHO pumps, comes the Hayward Tyler-Terry Turbine. Models ZI and ZSI are now being made under licence at Luton. Among many other outstanding features of this well-known turbine, the following may be recapitulated.

Steam radial flow turbine of single impulse type, no end thrust.

Solid forged wheel with vane passages milled out, leaving ample room for combating steam erosion.

Horizontal split casing, subject only to exhaust pressure, can be made in iron or steel to requirements.

Heavy section shaft mounted on ring oil bearings, arranged for water cooling at higher steam temperatures.

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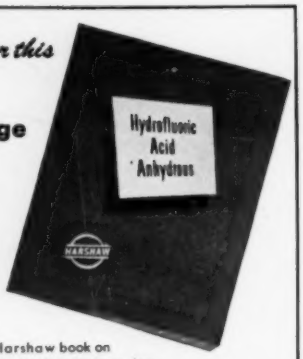

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GATX at Railroad Fair

General American Transportation Corp., builders and operators of a fleet of more than 55,000 tank cars and other special cars, will be represented at the Chicago Railroad Fair this year by a two-fold exhibit consisting of an all-welded, aluminum tank car and the latest development of refrigerator car for transporting frozen foods. This latter will be used as a display booth incorporating models of cars, photographs and actual products. Also featured will be the liquid storage terminals and the fabrication of heavy equipment used in the refinery and process industries, in addition to the company's car building activities and the design and building of Wiggins floating roofs, gas-holders and other structures for the conservation of valuable, volatile vapors.

Health Work in the Middle East

One of the problems faced by oil companies is that of looking after the health of their employees, and this is of particular importance to companies operating in tropical regions where devastating endemic diseases are prevalent. As one of the pioneers in the Persian Gulf area, the Caltex-Bahrein group of companies undertook sanitary measures of wide scope at the very outset of their operations.

Since malaria and other fevers were the most serious from the point of view of man-days lost, a full-scale campaign for malaria control and suppression on Bahrein Island was launched in 1946, under the direction of the medical department, entomological and sanitary engineers' staff, especially chosen for this work. The combined team has made a remarkable record in decreasing the incidence of malaria and time lost among personnel over the past two years, and the success of the anti-malaria campaign is indicated by the fact that loss of man-days due to that disease decreased between 60 and 75 percent from 1946 to 1947. Latest reports provide assurance that with constant effort and education malaria can be reduced to a minor cause of illness.

The excellent results of the work done on Bahrein Island has attracted the attention of others confronted with the same problems in the Persian Gulf area. Hence, when an invitation was sent out by the Bahrein Island Medical Society to attend a medical congress on November 4, 1948, thirty-six doctors attending the meeting. This congress, the first of its kind in this area, was in some ways of an experimental nature. It was desired primarily to exchange ideas held by European, American and Indian doctors as to etiology, diagnosis and treatment of diseases endemic in the area. Secondly it was felt desirable to determine the interest and the number of doctors who would attend such a congress, with a view to forming a more closely knit organization. Thirdly it was believed that a meeting of this kind would do much to stimulate medical thinking in a section where there is little access to large medical centers.

The meeting was organized by Dr. Robert J. Biggar, chief medical officer of the Bahrein Petroleum Company, Ltd., and president of the Bahrein Island Medical Society, and his staff. It was attended by representatives from the civilian, military and governmental fields of the medical profession from Kuwait, Saudi Arabia, Iran and other surrounding countries. The speakers covered a wide range of problems connected with regional health conditions, followed by round-table discussions. These resulted in the formation of the Persian Gulf Medical Society, with committees appointed to study the problems of the area, and sub-committees assigned to report on various phases for later correlation. This society will meet semi-annually and is expected to bring about further improvement in the health of the people of the Middle East.

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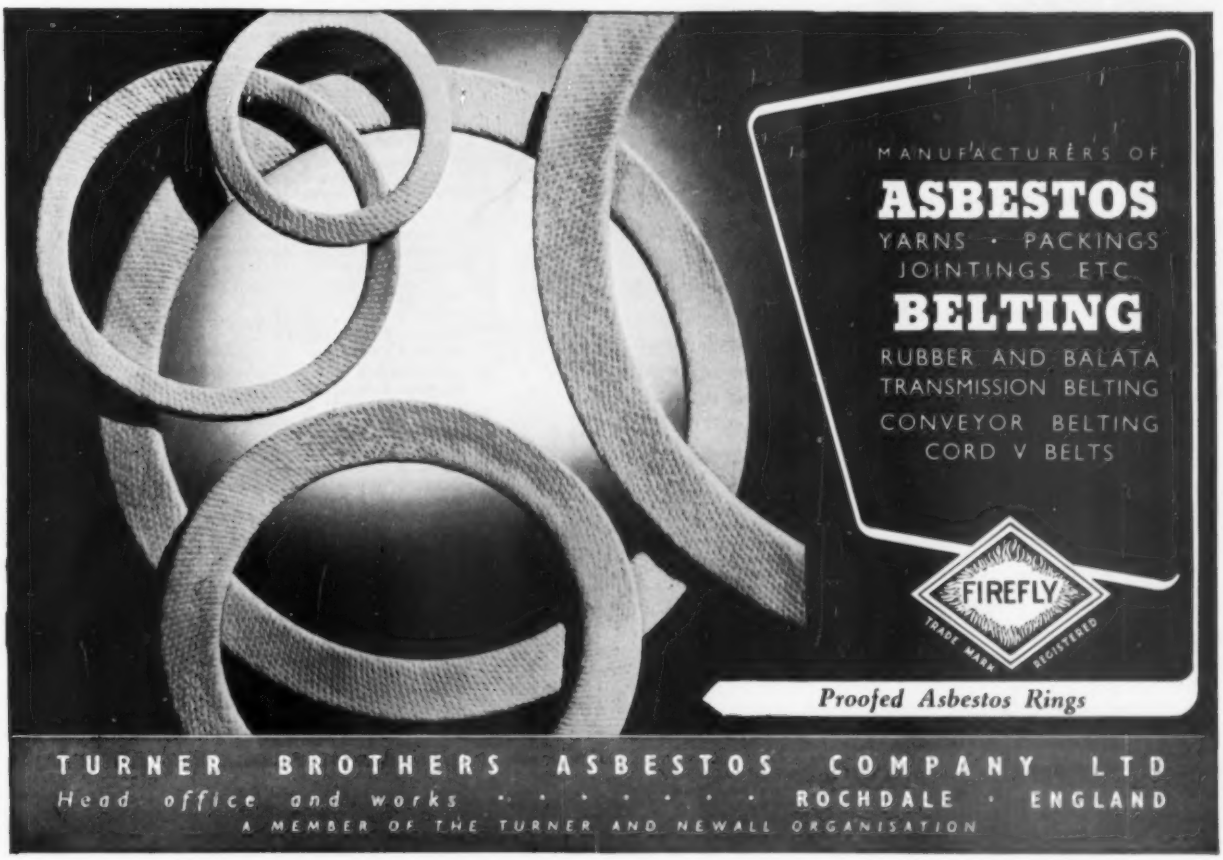
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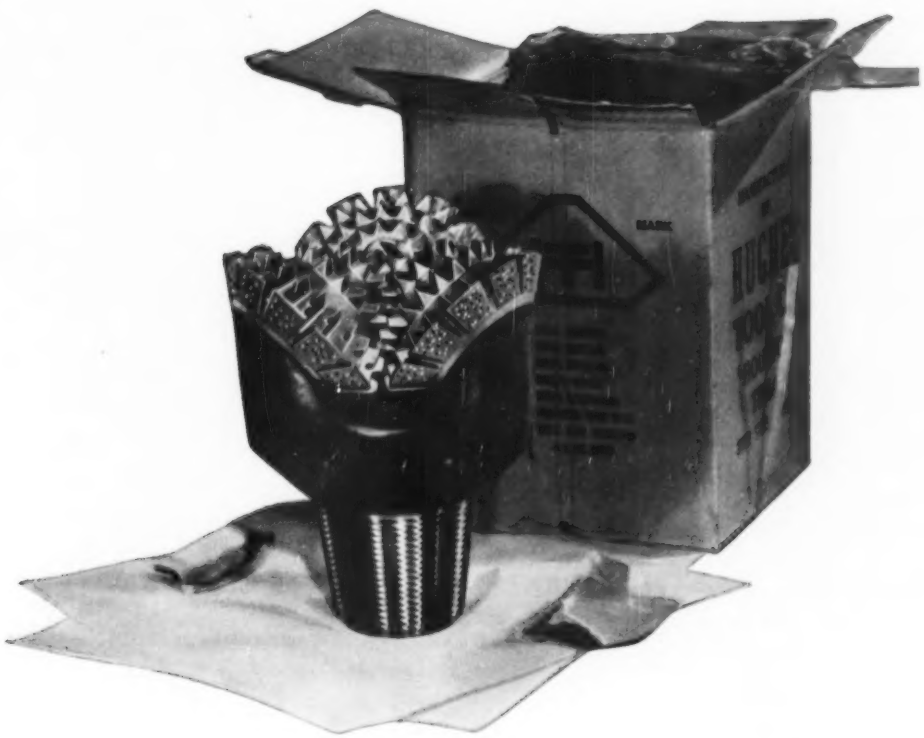

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